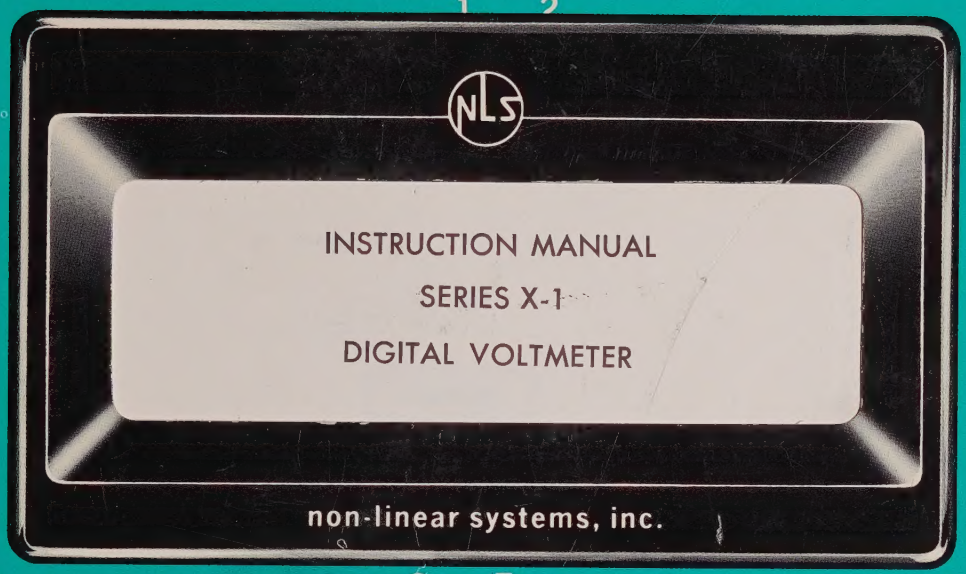


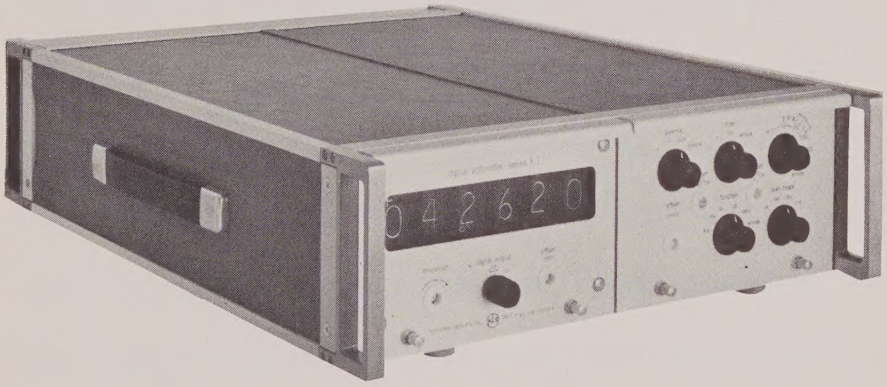
METROLOGY DEPT.

non linear systems, inc.

DEL MAR, CALIFORNIA

Document No. 812
January 1967

INSTRUCTION MANUAL
SERIES X-1
DIGITAL VOLTMETER



This Manual Applies to Series X-1 Digital Voltmeters
Bearing Part No. 36-468, 36-388, 36-472, or 36-382.

Originator of the Digital Voltmeter
non-linear systems, inc.
DEL MAR, CALIFORNIA

Printed in the United States of America

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CAUTION

THE SERIES X-1 DIGITAL VOLTMETER IS A PRECISION INSTRUMENT. DO NOT HANDLE THE 5TH DECADE PLUG-IN ASSEMBLY, P/N 36-16, UNLESS CLEAN RUBBER GLOVES ARE WORN. FINGERPRINTS, DIRT OR ANY FOREIGN MATTER ON COMPONENTS, CONNECTIONS OR PRINTED CIRCUIT BOARDS MAY CAUSE LEAKAGE PATHS WHICH CAN REDUCE ACCURACY OF THE INSTRUMENT.

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CHAPTER I

INTRODUCTION AND SPECIFICATIONS

The NLS Series X-1 Digital Voltmeter is a three-range, five-digit instrument with automatic range and polarity functions. Provisions for 20% over-ranging are incorporated. Its circuitry is all solid state and its principle of analog-to-digital conversion is all-electronic successive approximation scan logic. The instrument may be used as a bench model or may be rack-mounted.

SCOPE OF MANUAL

This manual specifically applies to four models of the Series X-1 Digital Voltmeter as described in the preceding paragraph. Two models have digital output and remote control capabilities (P/N's 36-468 and 36-472) and the others do not (P/N's 36-388 and 36-382). The power switch is located on the rear of instruments bearing P/N's 36-468 and 36-388 and on the front of instruments bearing P/N's 36-472 and 36-382. Table I lists the drawer assemblies and major subassemblies (with quantities) of each model. In addition to the basic DC voltage measurement, these four models of the Series X-1 are capable (at customer's option) of measuring ratio, AC voltage, millivolts and ohms. For ratio measurement, Reference Supply Assembly (P/N 36-11) is replaced by Ratio Reference Assembly (P/N 36-195). For AC measurement, either a 10 KHz or a 100 KHz AC converter is inserted into J12 of the Function Unit Assembly (right hand drawer). For MV measurement, a Pre-Amplifier Assembly is inserted into either J12 or J13 of the Function Unit Assembly. For KΩ measurement, an Ohms Converter Assembly is inserted into J13 of the Function Unit Assembly. To obtain six independent function line outputs, Transfer Board No. 2 Assembly (P/N 36-467) may be substituted for Transfer Board No. 2 Assembly (P/N 36-488). Two active filters (high speed and low speed) are also offered as optional accessories to be substituted for standard Filter Assembly 36-296. Refer to specifications under FILTERS. Schematic and wiring diagrams for each model and accessory will be found at the end of the manual.

ACCURATE AND STABLE

The Series X-1 operates as an automated version of the laboratory potentiometer, the most accurate voltage measuring device. That is, it generates a feedback voltage equal to the unknown input voltage in discrete steps, by operating a precision voltage divider, energized by a highly regulated power supply.

High-speed, reliable transistor switches operate the Series X-1's voltage divider, which is composed of precision resistors. The switches are so stable that adjustment potentiometers are not required to compensate for switch drift. Voltage for the divider is controlled by two Zener diodes which have been carefully selected to ensure that their combination results in a temperature coefficient sufficiently low to provide an ultra-stable supply. A temperature stabilizing oven is not required.

EASY TO SERVICE

The operational assemblies of the instrument are housed in three separate, easily removed, plug-in drawers and virtually all components within these drawers are mounted on plug-in

Table I. Series X-1 Model Variations by Assemblies

	REMOTE CONTROL AND PRINTOUT			WITHOUT REMOTE CONTROL AND PRINTOUT		
	(36-468)	(36-472)	QTY.	(36-388)	(36-382)	QTY.
Decade Counter Assembly	36-8	36-8	2	36-8	36-8	2
Reference Assembly	36-11	36-11	1	36-11	36-11	1
Decade (1-4) Assembly	36-14	36-14	4	36-14	36-14	4
Decade (5) Assembly	36-16	36-16	1	36-16	36-16	1
Comparator Assembly	36-26	36-26	1	36-26	36-26	1
Inverter Assembly	36-43	36-43	1	36-43	36-43	1
Decode Assembly	36-67	36-67	5	36-67	36-67	5
Threshold & Clock Assembly	36-73	36-73	1	36-73	36-73	1
Transfer Board No. 1 Assembly	36-179	36-179	1	-----	-----	0
Transfer Board No. 2 Assembly	36-488	36-488	1	-----	-----	0
Transfer Board No. 3 Assembly	36-185	36-185	1	-----	-----	0
Function Relay Assembly	36-191	36-191	1	36-191	36-191	1
Readout Unit Assembly	36-469	36-469	1	36-469	36-469	1
Power Supply Assembly	36-470	36-473	1	36-474	36-397	1
Function Unit Assembly	36-471	36-471	1	36-471	36-471	1
Rectifier Assembly	36-495	-----	1	36-495	-----	1
Program Counter Assembly*	36-249	36-249	2	36-249	36-249	1
Regulator Assembly	36-266	36-266	1	36-266	36-266	1
Polarity Flip-Flop Assembly	36-269	36-269	1	36-269	36-269	1
Range Counter Assembly	36-272	36-272	1	36-272	36-272	1
Scan Counter Assembly*	36-275	36-275	1	-----	-----	0
Filter Assembly	36-296	36-296	1	36-296	36-296	1
Buffer Assembly	36-314	36-314	1	36-314	36-314	1
Range Limit Logic Assembly	36-320	36-320	1	36-320	36-320	1
Range Decision Assembly	36-324	36-324	1	36-324	36-324	1
Scan Control Assembly*	-----	-----	0	36-494	36-494	1
Rectifier & Power Relay Assy.	-----	36-485	1	-----	36-485	1
Buffer Assembly**	36-555	36-555	1	36-555	36-555	1

*On DVM P/N 36-315:

1. Scan Control Assembly, 36-494, is substituted for Scan Counter Assembly, 36-275 (Connector J3 of Function Unit Assembly).
2. Program Counter Assembly, 36-249, is inserted into Connector J5 of Function Unit Assembly. Connector J4 (although wired for use) is without a board assembly.

**

1. S/N 331 and on.

circuit boards for easiest access and replacement. It is thus possible to keep the instrument operative with a minimum of down-time. For example, logic and feedback voltage generator circuits common to any one decade (readout window) are mounted on a separate board and four of the five decade boards (decades 1 thru 4) are completely interchangeable within the instrument. The five decode boards are also completely interchangeable. Should any of the first four decade boards or any of the decode boards fail, it can be omitted from the right-most (1st decade) and the Series X-1 will still operate, but as a 4-digit instrument (e.g., if the input were 4.7391, the readout would display 4.739). This maintenance philosophy enjoys wide acceptance among instrument users who require that both trained and untrained personnel be able to service the instruments.

MEASURING SPEED

The speed of the Series X-1 instrument, depending upon range and polarity changes required, will vary from 16 to 106 milliseconds per reading. Range changes occur when the previous measurement is not within the proper range for the new measurement; that is, the range changes only when required. Unlike many other instruments, the Series X-1 does not revert to the lowest range between readings.

"Range Memory" increases over-all measuring speed by preventing needless ranging. It does this by remembering the range last used and using it for the next measurement if suitable (i.e., if the next voltage is neither above full scale of the range last used, nor lower than 1/10 of it).

The Series X-1 utilizes fixed sequence logic. With this logic, the instrument creates a feedback voltage equal to the input, and feedback voltage changes are made decade by decade in one programmed scan, starting with the left-most decade (left-most readout window) and progressing to the right. Even if the input voltage varies during measurement, the instrument's reading represents a valid voltage value that existed during the measuring cycle. In contrast, instruments having digital servo logic (tracking logic) will "hunt" continuously as long as the input varies by more than one digit. Hunting can only be stopped by decreasing DVM comparison amplifier gain, which must be done manually since the gain should be reduced only enough to prevent hunting.

COMMON MODE REJECTION

Rejection of common-mode signals, those caused by AC or DC currents flowing between signal source ground and instrument chassis ground, is a key feature of the Series X-1 DVM. Common-mode signal rejection (CMR) is important in a wide range of applications - testing complex electrical and electronic systems, in automatic measuring systems, and measuring outputs from thermocouples, strain gages and other transducers where common-mode signals may be many times greater than the measured DC voltage.

FLOATING INPUT

Because input signal leads are not connected to the Series X-1's outer chassis, signal-to-chassis potentials up to 500 volts are permissible. Floating input adds to the DVM's versatility by permitting it to measure voltage sources which could not be accurately measured by a non-isolated meter.

The NLS Sales Representatives or Engineering Department will be pleased to assist you with specific application problems and, of course, will gladly welcome your comments and suggestions. A contact with the nearest NLS office or to the main office in Del Mar, California will bring prompt response.

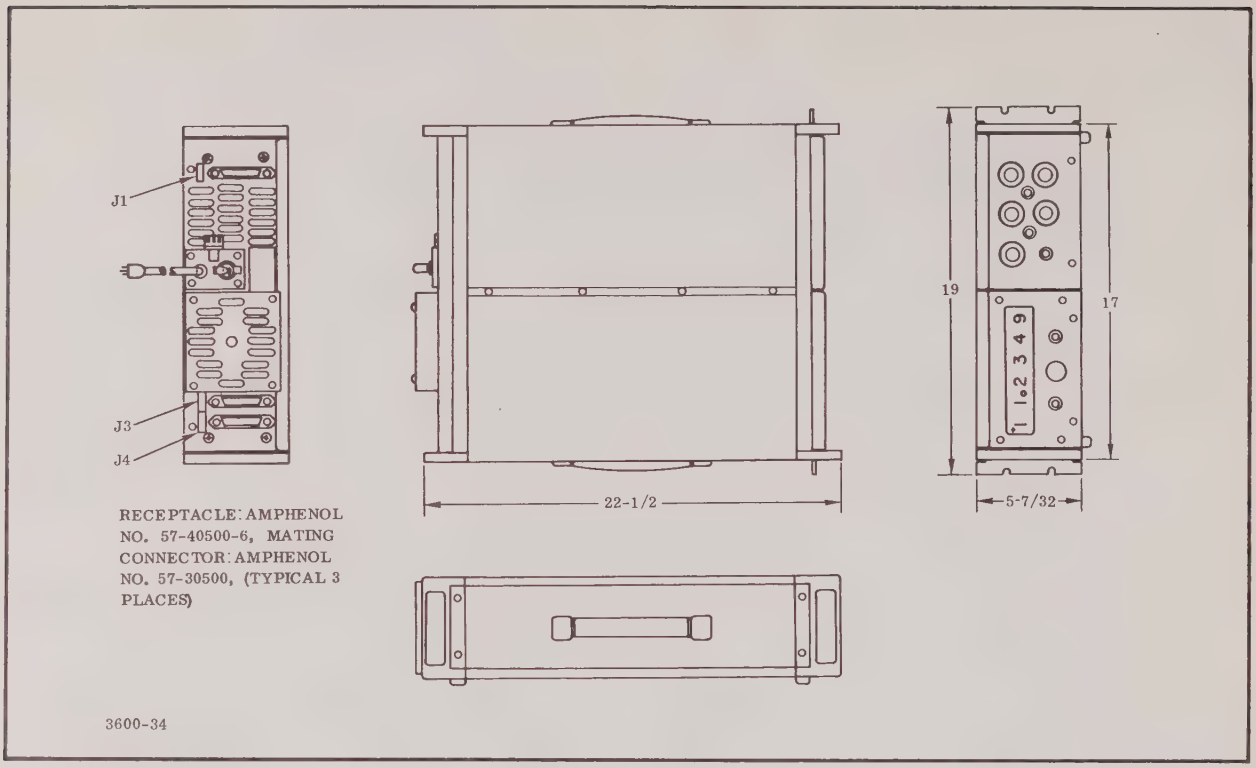


Figure 1-1. Dimension Diagram

SPECIFICATIONS, BASIC DVM

CIRCUITRY:	All solid state.
PRINCIPLE OF ANALOG-TO-DIGITAL CONVERSION:	All-electronic successive approximation scan logic.
COMMON-MODE REJECTION:	120 DB, VCD - 60 CPS.
FULL SCALE DC RANGES:	±9.9999, ±99.999, ±999.99 with 20% over-range on the two lower ranges.
ACCURACY UNDER ASA REFERENCE CONDITIONS:	0.001% of full scale +0.005% of reading.
RESOLUTION:	One digit
RESPONSE TIMES:	Input Buffer Response Time - 10 MS.
	Digitizing Time - 6 MS.

RESPONSE TIMES (CONT):	Time Required for Transfer Relays to Operate - 7 MS.
	Time to Select a Fixed Range Remotely (Operate Time of Range Transfer Relay + Operate Time of Range Selection Relay) - 10 MS.
	Time Required for Each Automatic Range Change - 30 MS.
	Time Required for Each Automatic Polarity Change - 30 MS.
INPUT RESISTANCE:	10V Range - 10,000 megohms.
	100V Range and 1,000 Range - 10 megohms.
	Input resistance is constant except when input is overloaded.
FILTERS:	Manual and Remote Switching
Standard	37 DB minimum at 60 Hz Settling time - 2 seconds to 0.01% with up to 100K source resistance.
Options	
Active (high speed)	36.5 DB minimum at 60 Hz Settling time - 170 MS to 0.01% with 10K source resistance
Active (low speed)	76 DB minimum at 60 Hz Settling time - 750 MS to 0.01% with 10K source resistance
METHODS OF CONTROL:	Range Selection - Automatic, manual and remote.
	Polarity Selection - Automatic, manual and remote.
	Start Command - Internal, external and manual.
	Function Selection - Manual and remote.
OUTPUT CONNECTIONS:	Output Data - BCD contact closures for isolated output. BCD voltage levels if isolation is not required.
	Digital Output Command - Contact closure for isolation. Voltage level if isolation is not required.
SIGNAL INPUT CONNECTIONS:	Signal inputs are on rear panel only. They consist of Sense Hi, Sense Lo, Guard, Current +, Current -, and Ref. In. These inputs may be floated ±500 VDC with respect to chassis ground (earth).

AMBIENT TEMPERATURE:	12^{o}C to 40^{o}C.
POWER REQUIREMENTS:	115 VAC, 50 - 60 CPS.
MOUNTING POSITION:	Due to the mercury-wetted relay, utilized for polarity switching, the mounting position must be restricted to within 30^{o} of horizontal.
WEIGHT:	Approximately 50 pounds.

RATIO SPECIFICATIONS

RANGES:	±1.19999/±11.9999/±99.999
ACCURACY UNDER ASA RATED CONDITIONS:	0.001% FS + 0.002% reading (short term)

PREAMPLIFIER SPECIFICATIONS

RANGES:	119.99, 1199.99 MVDC
ACCURACY UNDER ASA REFERENCE CONDITION:	±(0.01% of reading +0.01% of full scale)
STABILITY:	Short Term: ±(0.01% of full scale) Long Term: See rated accuracy
RESPONSE TIME:	Step to 0.01% of final value: 1 second* Each range change to 0.01% of final value: 1 second*
INPUT CHARACTERISTICS:	Resistance, Steady State: 100 MΩ, minimum Resistance, Dynamic: 20 KΩ, minimum

AC/DC CONVERTER SPECIFICATIONS

RANGES:	Type I - Frequency: 50 Hz to 10 KHz Type II - Frequency: 50 Hz to 100 KHz Type I - Amplitude: 1.19999, 11.9999, 119.999, 500.00 VAC Type II - Amplitude: 1.19999, 11.9999, 119.999, 500.00 VAC @ 10 KHz decreasing to 150 VAC @ 100 KHz

*Response time is considerably increased for signals whose source resistance is higher than 10 KΩ.

ACCURACY UNDER ASA REFERENCE CONDITION:	Type I - ±(0.01% of reading +0.05% of full scale)
	Type II - ±(.1% of reading +.05% of full scale) 50 Hz to 10 KHz ±(.3% of reading +.1% of full scale) 10 KHz to 30 KHz ±(.5% of reading +.1% of full scale) 30 KHz to 100 KHz
STABILITY:	Short Term: ±0.02% of full scale
	Long Term: See rated accuracy
RESPONSE TIME:	Step to 0.1% of final value: 600 milliseconds
	Range to 0.1% of final value: 630 milliseconds
INPUT CHARACTERISTICS:	Resistance: 1 meg ±1% (all ranges)
	Capacitance: 100 PF maximum (all ranges)

KΩ-DC CONVERTER SPECIFICATIONS

RANGES:	1.19999, 11.9999, 119.999, 1199.99, 11999.9 KΩ
ACCURACY UNDER ASA REFERENCE CONDITIONS:	±(0.01% of reading +0.001% of full scale), lowest three ranges ±(0.03% of reading +0.001% of full scale), 1,000 KΩ range ±(0.1% of reading +0.001% of full scale), 10,000 KΩ range
STABILITY:	Short Term: ±(0.005% of full scale), lowest three ranges Long Term: See rated accuracy
RESPONSE TIME:	Step to 0.01% of Final Value, 4 Lowest Ranges: 100 MS 0.1% of Final Value, Highest Range: 0.7 SEC
	Each Range Change to 0.01% of Final Value: 630 milliseconds* (Highest range settles to 0.2% in 630 milliseconds)
TEST VOLTAGES AND CURRENTS:	Voltage across unknown: 16 VDC all ranges
	Current through unknown: 10 MA lowest range 1 MA on higher ranges

*If highest range is not needed, speed can be markedly improved.

CHAPTER II

INSTALLATION AND OPERATION

UNPACKING

The instrument is shipped in a heavy cardboard container. Cut the tape on the top of the container and open. If damage is seen, promptly notify the carrier. No packing materials are used inside of the instrument and it is ready for use when taken out of the shipping container. It is suggested that the container be saved if future storage or shipment is contemplated.

MOUNTING

The unit may be mounted in a standard 19-inch mounting rack (mounting brackets for this utilization are provided) or may be used as a bench instrument. Due to the mercury-wetted relay utilized for polarity switching, the mounting position must be restricted to within 30^{o} of horizontal.

POWER SOURCE

The instrument requires a 115-volt, 50-60 cycle, single-phase power source for operation.

FUSING

The instrument is protected by a 3AG one-ampere slo-blo fuse which is located in an extractor post on the rear of the power supply unit.

POWER GROUNDING

The third pin of the power plug grounds the outer chassis of the instrument (Figure 2-1). The three internal drawers have no connection to chassis ground.

CABLE CONNECTIONS

The instrument is supplied with an input cable for connection to input connector J1 (see Figure 2-2, cable drawing 15004-525 and applicable calibration instructions for connection information.) Mating connectors are supplied for remote control connector J3 and

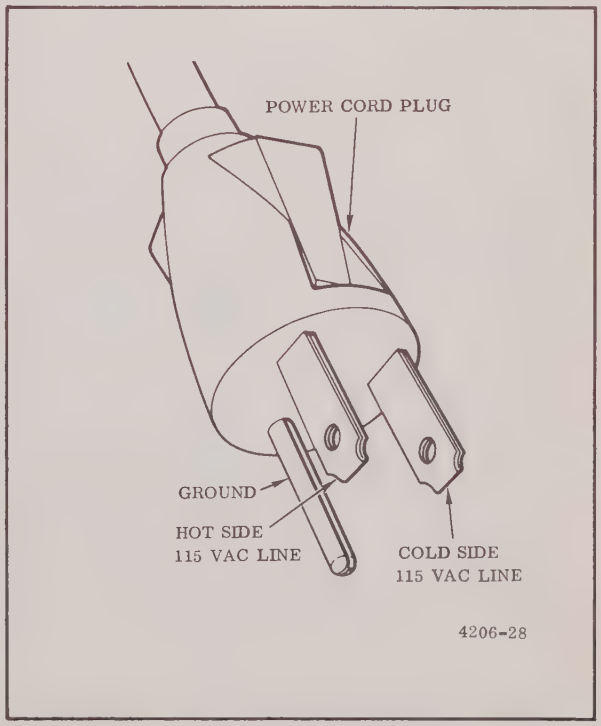


Figure 2-1. Power Plug Pin Coding

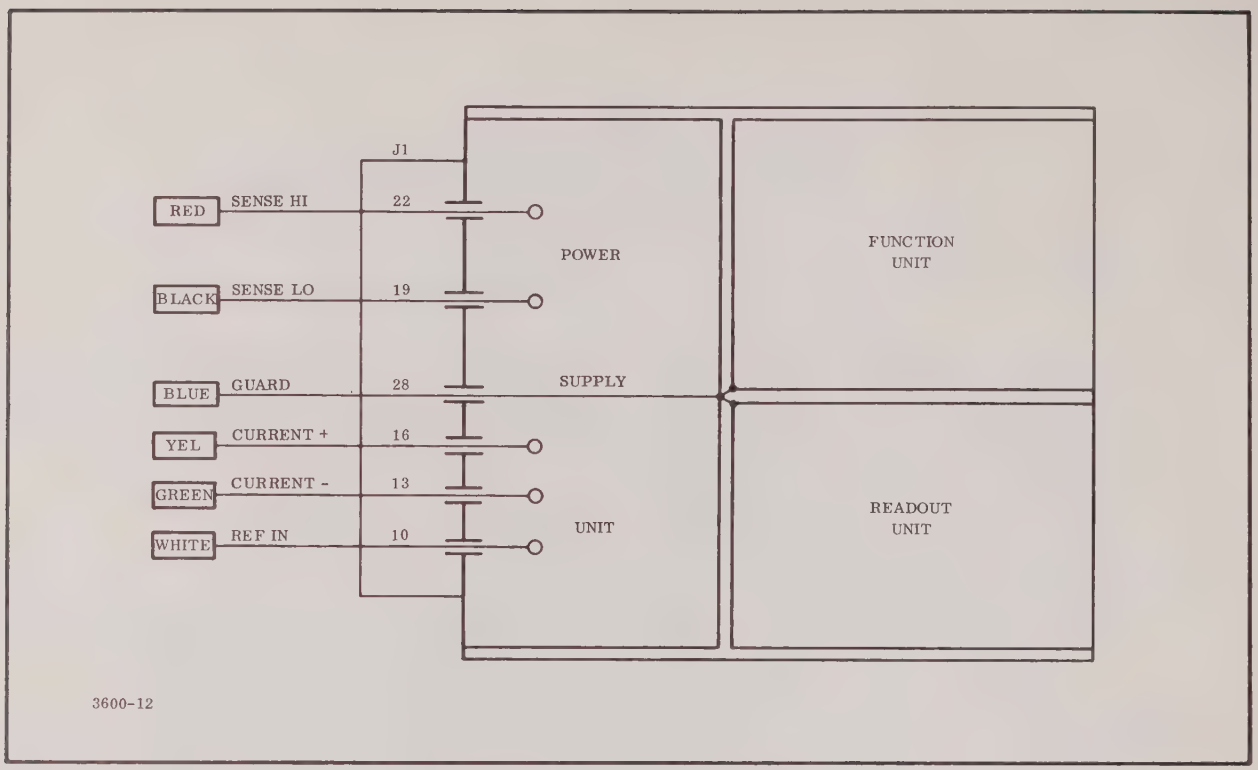


Figure 2-2. Input Connections

digital output connector J4 (see drawing number 36-468, sheet 4, or 36-472, sheet 4, for connection information). See Figure 2-3 for location of all connectors.

CONTROLS

READOUT UNIT

Threshold Control

Associated with any number stored in the decade flip-flops (and displayed in the readout), is a dead band from which the input signal must emerge (in the positive or negative direction) before a new measurement will result in a new reading.

The THRESHOLD control (a screwdriver-adjust potentiometer) is used to set the width of the dead band. With the control in the extreme counterclockwise position, the dead band width is essentially zero. With the control in the extreme clockwise position, the dead band width is approximately 10 digits, in the least significant decade.

Measurement of inputs outside the dead band are made at full accuracy, the effect of the THRESHOLD control being automatically cancelled out.

The THRESHOLD control can be used to reduce bobble in the readout display.

Digital Output Switch

The DIGITAL OUTPUT control (DVM P/N's 36-468 and 36-388) is a three position switch in series with the common line which, when

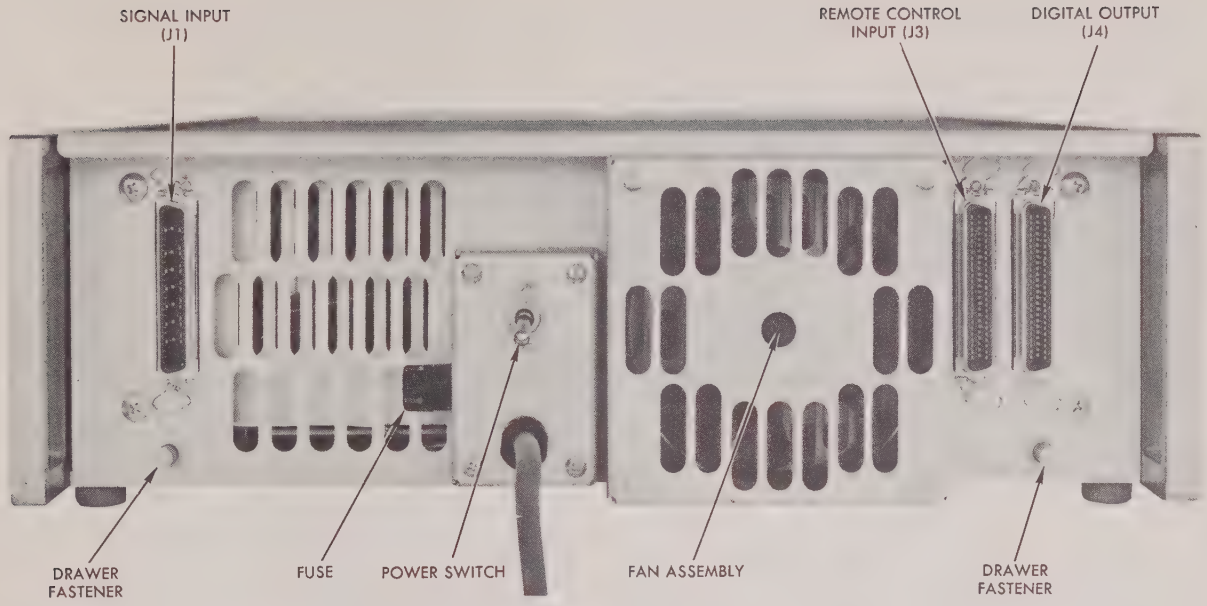
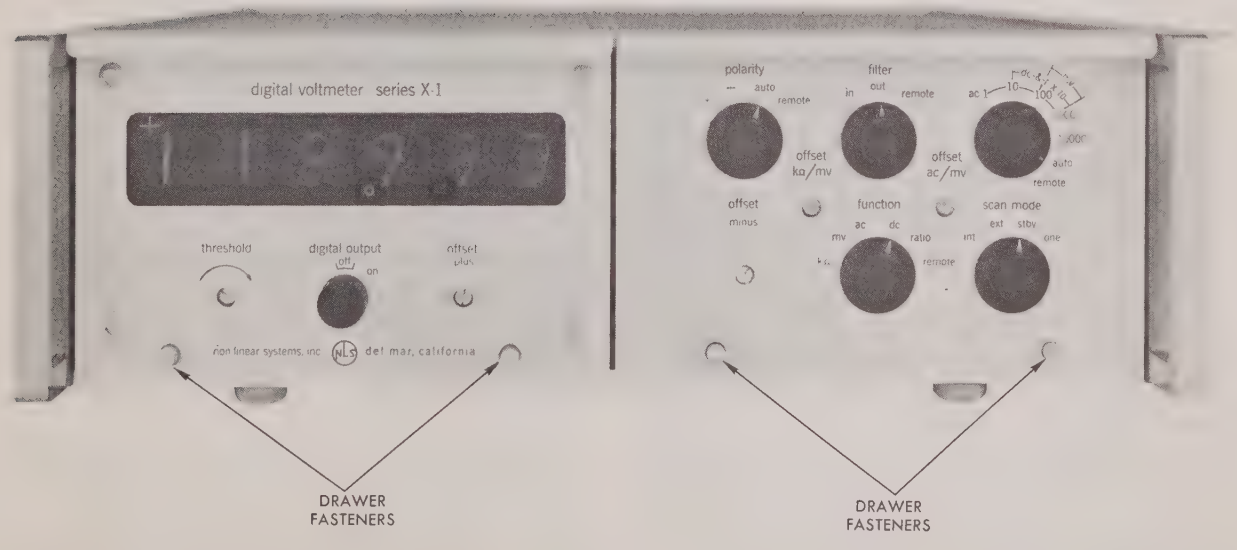


Figure 2-3. Rear View



3600-35

Figure 2-4. Front View

the switch is ON, feeds the coils of the data transfer relays and the print command relay. Whenever the instrument is not being used with a recording device, it is recommended that the DIGITAL OUTPUT switch be placed in the OFF position to prolong the life of the transfer relays. The ON position of this switch is wholly ineffective on the Series X-1 model without remote control and printout capabilities (P/N 36-388). For digital output control of the Model X-1 bearing part number 36-472 refer to the following paragraph.

POWER SWITCH (DVM P/N's 36-472 and 36-382)

The POWER switch is a three-position switch labeled OFF, ON and RECORD. When in the OFF position, the power relay located on the Rectifier and Power Relay Assembly (P/N 36-485) is de-energized. In the ON position, the instrument is ready to provide readings. For maximum specified accuracy, a warm-up period of 30 minutes is recommended. When in the RECORD position, the switch feeds the coils of the data transfer relays and the print command relay. Whenever the instrument is not being used with a recording device, it is recommended that the POWER switch be placed in the ON position to prolong the life of the transfer relays. The RECORD position of this switch is wholly ineffective on the Series X-1 model without remote control and printout capabilities (P/N 36-382).

Offset Plus Control

The OFFSET PLUS control is a screwdriver-adjust potentiometer which, when in the plus polarity only, can offset the meter reading by up to approximately ten digits (except when the reading is near all zeros). Its use is described in Section III, Calibration Instructions under Zero Offset Adjustments.

FUNCTION UNIT

Polarity Switch

The POLARITY switch is a four position switch providing for the manual selection of either plus (+) or minus (-) polarity readings or, as when in the AUTO position, allowing the instrument to automatically select the proper polarity. When the switch is placed in the REMOTE position, polarity selection may be made by an external triggering device.

Filter Switch

The FILTER switch has three positions. When in the OUT position, the filter is disconnected. When in the IN position, the filter is connected and the reading time of the instrument is automatically increased to allow for filter response time. When the switch is placed in the REMOTE position, filter selection may be made by an external triggering device.

Range Switch

The RANGE switch has seven positions. When in the 1 position, the instrument is locked in the 1-volt range for the measurement of AC voltages or in the 1KΩ range for the measurement of ohms. When in the 10 position, the instrument is locked in the 10-volt range for the measurement of AC, DC and ratio voltages or in the 10KΩ range for the measurement of ohms. When in the 100 position, the instrument is locked in the 100-volt range for the measurement of AC, DC and ratio voltages, in the 100 MV range for the measurement of millivolts or in the 100KΩ range for the measurement of ohms. When in the 1000 position, the instrument is locked in the 1000-volt range for the measurement of AC, DC and ratio voltages, in the 1000 MV range for the measurement of millivolts or in the

1 MEG range for the measurement of ohms. When in the 10000 position, the instrument is locked in the 10 MEG range for the measurement of ohms. When in the AUTO position, the instrument automatically selects the proper range. When in the REMOTE position, range selection may be made by an external triggering device.

Offset Minus Control

The OFFSET MINUS control is a screwdriver-adjust potentiometer which, in the minus polarity only, can offset the meter reading by up to approximately ten digits (except when the reading is near all zeros). Its use is described in Section III, Calibration Instructions under Zero Offset Adjustments.

Scan Mode Switch

The SCAN MODE switch has four positions. When in the INT. position, the readings are initiated internally. When in the EXT. position, the readings are initiated externally by de-energizing the trigger hold-off relay (see drawing number 36-468, sheet 4). If only a single reading is desired, the trigger holdoff relay should be de-energized and then energized within a period of seven milliseconds. When in the STBY. position, the power is on but the instrument cannot be triggered either internally or externally and the last measurement remains stored. The ONE position is spring loaded. Moving the switch to this position causes the instrument to make a single measurement. If a recording device is in use, returning the switch from the ONE position to the STBY. position causes the data obtained from the single measurement to be transferred to the recording device. The EXT. position is ineffective on the Series X-1 models without remote control and printout capabilities (P/N's 36-388 or 36-382).

Function Switch

The FUNCTION switch is a six-position switch provided to manually select the five functions of either DC, RATIO, MV, AC, or KΩ; the sixth position (REMOTE) is provided to allow the function selection to be made by an external triggering device.

KΩ/MV Offset Control

The KΩ/MV OFFSET control is a screwdriver-adjust potentiometer provided to zero the instrument when in the KΩ or MV function. Its use is described in the KΩ and MV calibration instructions.

AC/MV Offset Control

The AC/MV OFFSET control is a screwdriver-adjust potentiometer provided to zero the instrument when in the AC or MV function. Its use is described in the AC and MV calibration instructions.

POWER SUPPLY UNIT

Power Switch (DVM P/N's 36-468 and 36-388)

The power switch is a two-position toggle switch located on the rear of the power supply unit. In the OFF position, the instrument is de-energized and both power leads are isolated from the power source; however, connection is maintained between the outer chassis and AC power line ground. In the ON position, the instrument is ready to provide readings. For maximum specified accuracy, a warm-up period of 30 minutes is recommended.

CHAPTER III

CALIBRATION

In the calibration instructions provided in this section, it is assumed that the instrument is in good working order and only requires calibration. If any components are defective, it may be difficult, if not impossible, to calibrate the instrument properly.

SCOPE

The basic DC calibration procedure is divided into six distinct areas: zero offset adjustments; 10-volt range calibration for a positive input; 10-volt range calibration for a negative input; 100-volt range calibration; 1000-volt range calibration; and zero offset readjustment with DVM in outer chassis.

Since the Series X-1 instruments, described in this manual, are capable of ratio, millivolts, AC and ohms measurements, at customer option, calibration procedures for these accessories are also included.

NOTE

Due to the mercury-wetted relay, used for polarity switching, the mounting position of the DVM must be restricted to within 30^{o} of horizontal.

DC VOLTAGE CALIBRATION

EQUIPMENT REQUIRED

1. A voltage standard between 9.0000 volts and 11.9998 volts, to calibrate the 10-volt range.
2. A voltage standard between 90.000 volts and 119.998 volts, to calibrate the 100-volt range.
3. A voltage standard between 900.00 volts and 1000.00 volts, to calibrate the 1000-volt range.

NOTE

It should be noted that the error in making a measurement with the Series X-1 DVM can be as much as the stated accuracy of the instrument plus the accuracy of the voltage standards used in its calibration.

INITIAL PREPARATION

Calibration with Drawers in Outer Chassis

Calibration may be made with the drawers removed from the outer chassis as described below, however the instrument should be calibrated with the drawer assemblies installed in the outer chassis. The blue plastic outer cover over the Function Unit Assembly (right hand drawer) may be removed to provide labeled access holes (Figure 3-1) for each calibration adjustment on plug-in module assemblies. To remove the outer cover and begin calibration, perform the following steps (Figure 3-2):

1. Remove the four white nylon screws from the center plastic divider on top of the instrument.

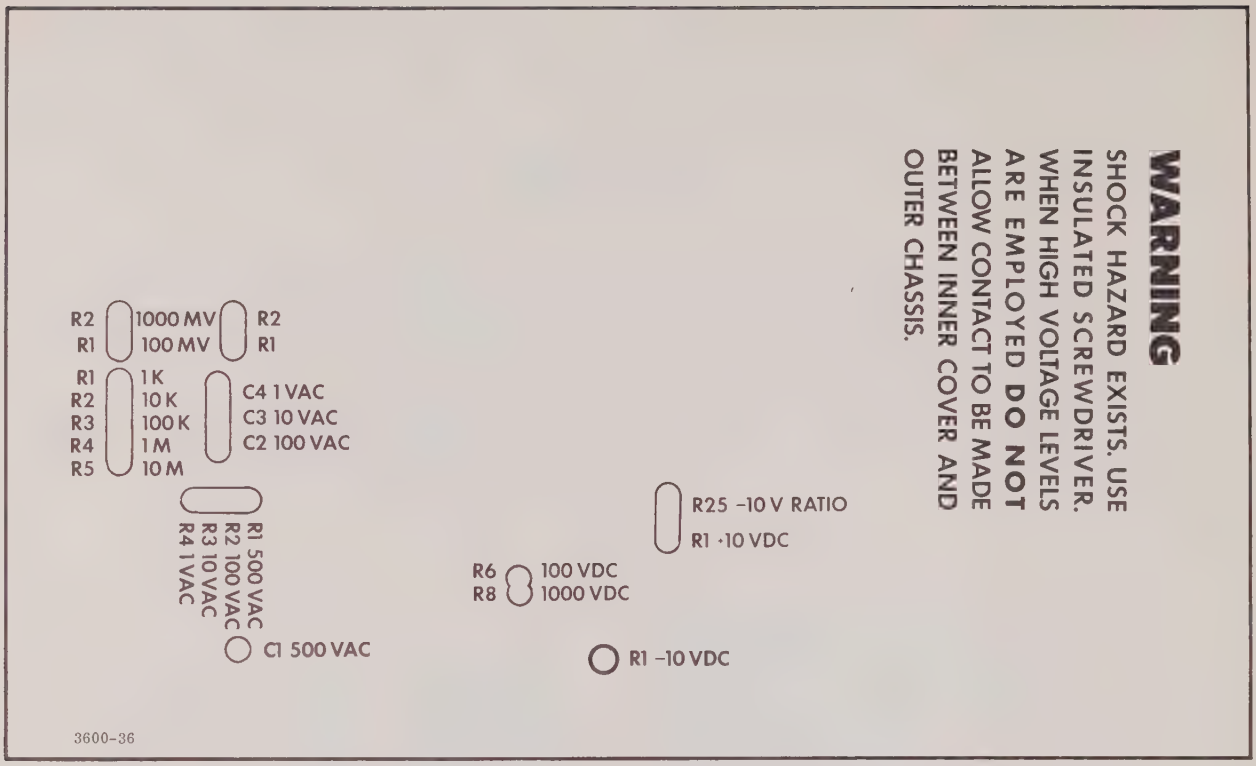


Figure 3-1. Labeled Access Holes on Inner Cover

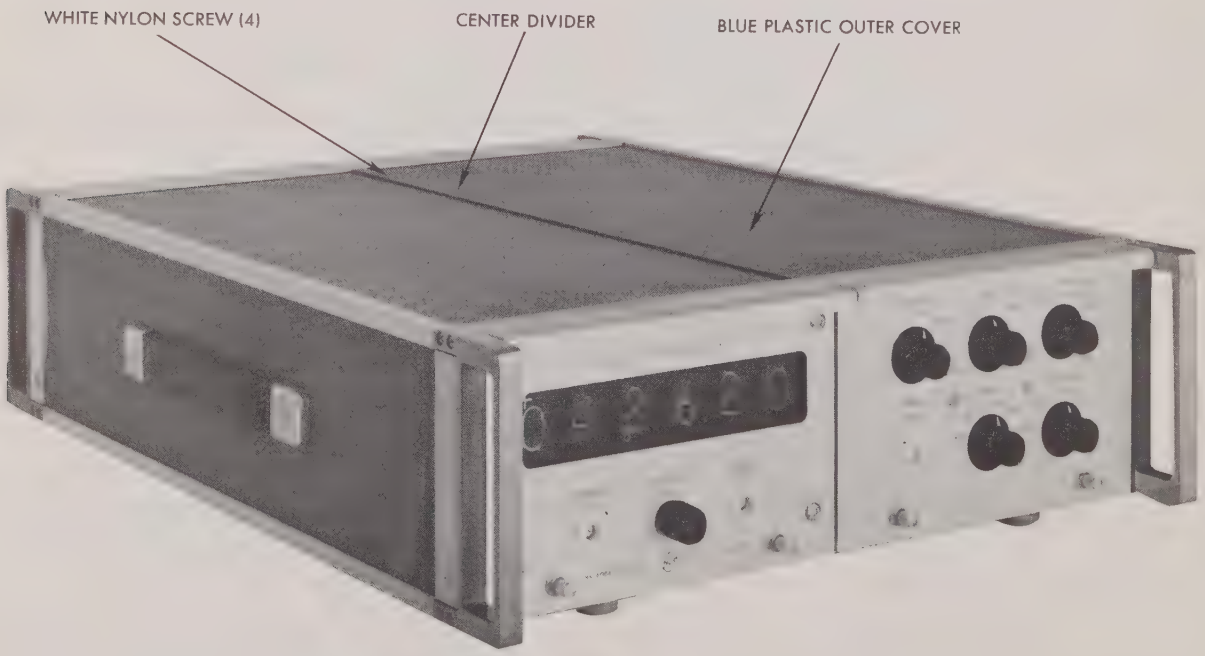


Figure 3-2. Outer Cover Removal

2. Remove the divider.

3. Grasp the right hand outer cover at its center where the divider had been installed.

4. Carefully bow the cover upward and pull it away from the side edge of the instrument.

5. Continue to bow the cover until it becomes loosened from the front and rear edges of the instrument.

WARNING

Shock hazard exists. Use insulated screwdriver when high voltage levels are employed. DO NOT allow contact to be made between inner cover and outer chassis.

6. Turn the instrument on and allow 30 minutes for warm-up, then begin calibration as described under paragraph headed PROCEDURE.

The cover may be replaced in the reverse order of removal, however if one of the white nylon screws has been lost, NEVER use a metal screw in its place. A metal screw in contact with the inner cover would produce the shock hazard described in the above warning.

Calibration with Drawers Removed

CAUTION

Do not disconnect drawer assemblies with power on. Damage to plug-in modules may result.

1. Loosen (turn counterclockwise) the two fasteners on each of the three drawers and remove the drawers from the outer chassis of the instrument.

2. Connect the three drawers together and plug the power cord into a 115 VAC, 50-60 CPS power source.

3. Turn the instrument on and allow 30 minutes for warm-up.

PROCEDURE

Zero Offset Adjustments

1. Place FUNCTION switch in the DC position.

2. Place SCAN MODE switch in the INT. position.

3. Place RANGE switch in the 10 position.

4. Turn THRESHOLD potentiometer adjustment fully counterclockwise.

5. Place POLARITY switch in the plus (+) position.

6. Connect the red, black and blue clips of the DVM input cable together. Rotate the OFFSET PLUS potentiometer to a position which causes the readout to alternate between +00.0000 and +00.0001, then rotate the potentiometer approximately 10 degrees counterclockwise.

7. Place the POLARITY switch in the minus (-) position.

8. Rotate the OFFSET MINUS potentiometer to a position which causes the readout to alternate between -00.0000 and -00.0001, then rotate the potentiometer approximately 10 degrees counterclockwise.

9. This completes the zero offset adjustments. If the adjustments have been made correctly, the readout should display a steady + or -00.0000 with the input leads shorted together and the POLARITY switch in the AUTO position.

10-Volt Range Calibration for a Positive Input Voltage

1. Connect the "guard" (blue) and "input low" (black) leads of the DVM input cable to the negative terminal of the voltage standard described in paragraph 1 under Equipment Required. Connect the "input high" (red) lead to the positive terminal (Figure 3-3).

2. Place the POLARITY switch in the plus (+) or AUTO position.

3. The numerical value displayed in the readout should be equal to the voltage of the voltage standard. If it is not, adjust potentiometer R1 of the Reference Assembly (P/N 36-11) until the readout displays the correct value. If the instrument has a Ratio measurement function, the adjustment potentiometer will be R1 of the Ratio Reference Assembly (36-195). See Figure 3-4 for location of major subassemblies and adjustment potentiometers for this step and for appropriate following steps in these procedures.

10-Volt Range Calibration for a Negative Input Voltage

1. Reverse the connections to the voltage standard.

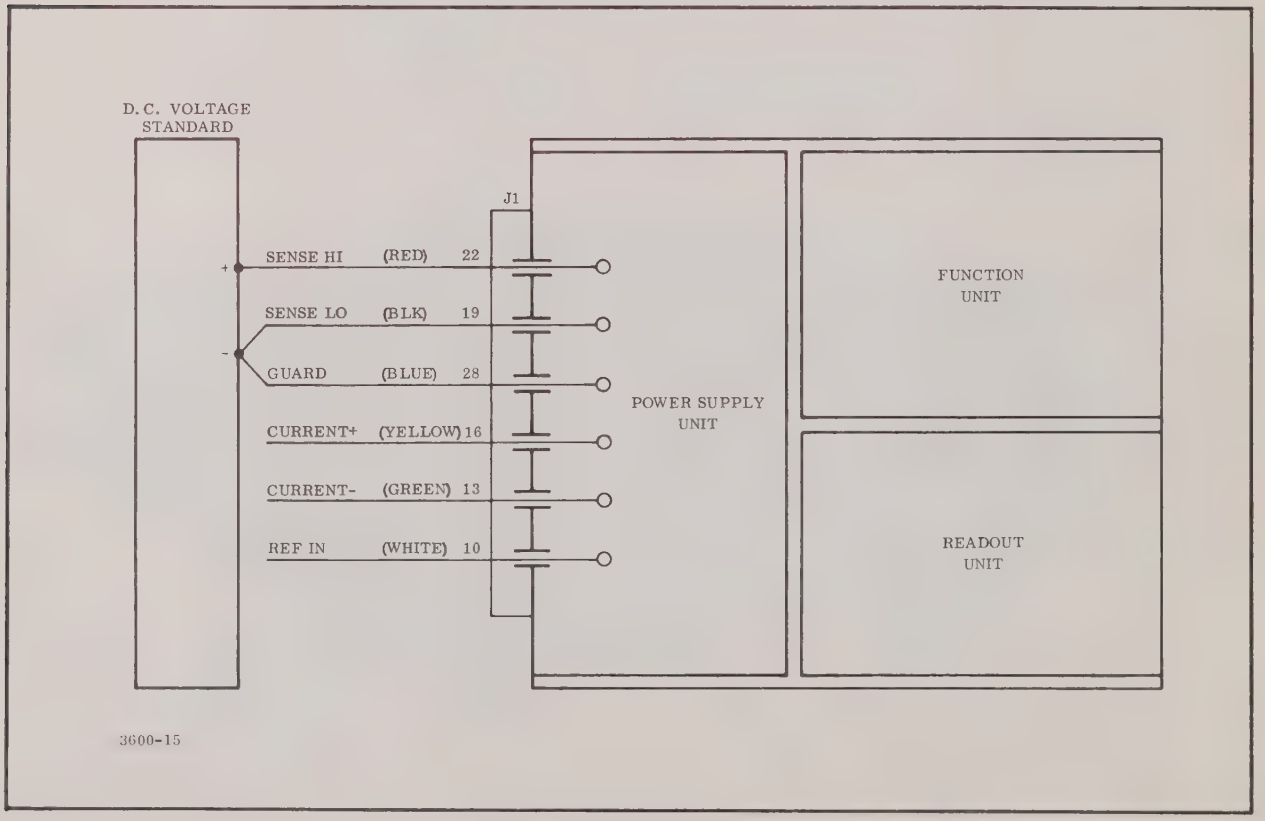
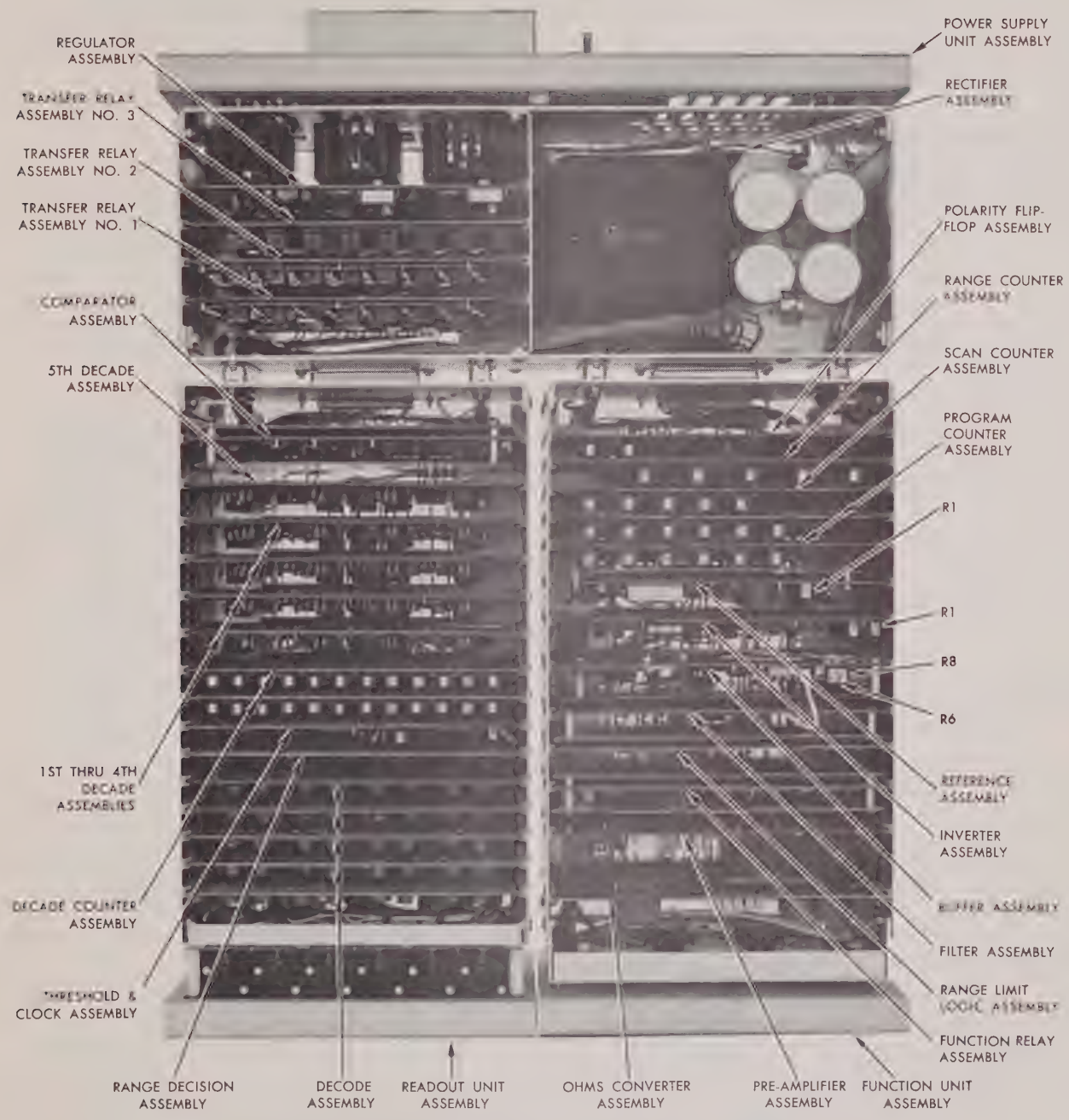


Figure 3-3. DC Volts and MV Calibration Cable Connections



3600-16

Figure 3-4. Location of Assemblies and DC Voltage Adjustment Points

2. Place the POLARITY switch in the minus (-) or AUTO position.

3. The numerical value displayed in the readout should be equal to the voltage of the voltage standard. If it is not, adjust potentiometer R1 of the Inverter Assembly (P/N 36-43) until the readout displays the correct value.

WARNING

Use extreme caution in performing the following steps as dangerously high voltages will be employed.

100-Volt Range Calibration

1. Place the POLARITY switch in the plus (+) or AUTO position.

2. Place the RANGE switch in the 100 position.

3. Connect the "guard" (blue) and "input low" (black) leads of the DVM input cable to the negative terminal of the voltage standard described in paragraph 2 under Equipment Required. Connect the "input high" (red) lead to the positive terminal (Figure 3-3).

4. The numerical value displayed in the readout should be equal to the voltage of the voltage standard. If it is not, adjust potentiometer R6 of the Buffer Assembly (P/N 36-314) until the readout displays the correct value.

WARNING

Use extreme caution in performing the following steps as dangerously high voltages will be employed.

1000-Volt Range Calibration

1. Ensure that the POLARITY switch remains in the plus (+) or AUTO position.

2. Place the RANGE switch in the 1000 position.

3. Connect the "guard" (blue) and "input low" (black) leads of the DVM input cable to the negative terminal of the voltage standard described in paragraph 3 under Equipment Required. Connect the "input high" (red) lead to the positive terminal (Figure 3-3).

4. The numerical value displayed in the readout should be equal to the voltage of the voltage standard. If it is not, adjust potentiometer R8 of the Buffer Assembly (P/N 36-314) until the readout displays the correct value.

Zero Offset Readjustment with DVM in Outer Chassis

1. Place the three drawers of the DVM into the outer chassis.

2. Ensure 30 minutes for instrument warm-up.

3. Perform steps 1 through 8 and note step 9 under Zero Offset Adjustments. This completes the calibration of the DVM.

RATIO CALIBRATION

ADDITIONAL EQUIPMENT REQUIRED

1. None.

INITIAL PREPARATION

1. Ensure that the instrument is properly calibrated in the DC voltage measurement function.

2. Either perform steps 1 thru 6 under Calibration with Drawers in Outer Chassis or steps 1 thru 3 under Calibration with Drawers Removed.

PROCEDURE

1. Connect the leads of the DVM as shown in Figure 3-5 to the voltage standard described in paragraph 1 under Equipment Required, DC Voltage Calibration.

2. Place the SCAN MODE switch in the INT. position.

3. Place the POLARITY switch in the negative (-) position.

4. Place the FILTER switch in the OUT position.

5. Place the FUNCTION switch in the RATIO position.

6. Turn the THRESHOLD potentiometer adjustment fully counterclockwise.

7. Place the RANGE switch in the 10 position.

8. Apply 10 volts and adjust R25 of the Ratio Reference Assembly (Figure 3-6) until the readout displays -1.00000. This step completes the calibration of the Ratio Reference Assembly.

PRE-AMPLIFIER CALIBRATION

ADDITIONAL EQUIPMENT REQUIRED

1. A voltage standard between 90.000 millivolts and 119.998 millivolts, to calibrate the 100-millivolt range.

2. A voltage standard between 900.00 millivolts and 1199.98 millivolts, to calibrate the 1000-millivolt range.

INITIAL PREPARATION

1. Ensure that the instrument is properly calibrated in DC voltage measurement function.

2. Either perform steps 1 thru 6 under Calibration with Drawers in Outer Chassis or steps 1 thru 3 under Calibration with Drawers Removed.

PROCEDURE

1. Place the SCAN MODE switch in the INT. position.

2. Turn the THRESHOLD potentiometer adjustment fully counterclockwise.

3. Place the RANGE switch in the 100 MV position.

4. Place the FUNCTION switch in the MV position.

5. Place the POLARITY switch in the AUTO position.

6. Place the FILTER switch in the OUT position.

7. Connect the red, black and blue leads of the DVM input cable together. If the Pre-Amplifier Assembly is inserted into J13 of the Function Unit Assembly, adjust the KΩ/MV OFFSET potentiometer until the readout displays 000.000. If the Pre-Amplifier Assembly is inserted into J12 of the Function Unit Assembly, adjust the AC/MV OFFSET potentiometer until the readout displays 000.000.

8. Connect the input leads of the DVM input cable as shown in Figure 3-3 to the voltage standard described in paragraph 1 under Additional Equipment Required.

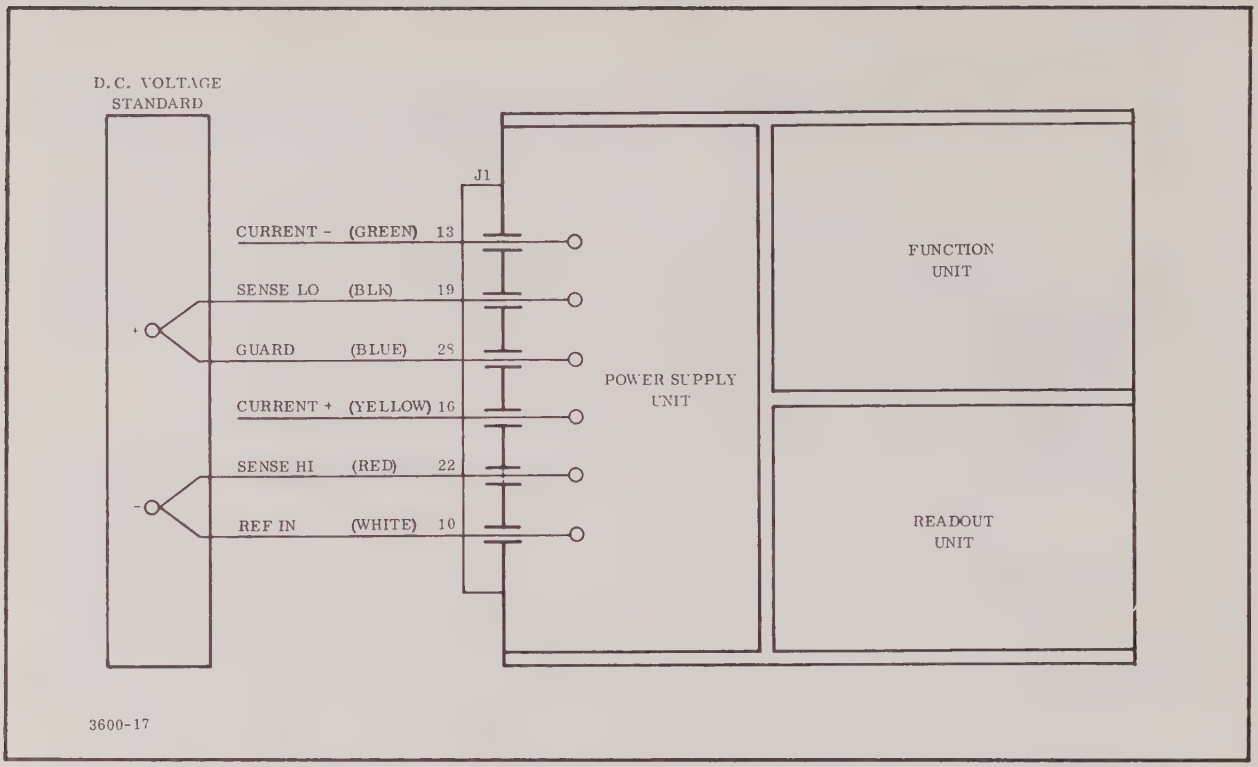


Figure 3-5. Ratio Reference Assembly Calibration Cable Connections

9. Apply approximately 95.000 millivolts and adjust R1 of the Pre-Amplifier Assembly (Figure 3-7) until the numerical value displayed in the readout is equal to the voltage of the voltage standard.

10. Connect the leads of the DVM input cable as shown in Figure 3-3 to the voltage standard described in paragraph 2 under Additional Equipment Required.

11. Place RANGE switch in the 1000 position. Apply approximately 950.000 millivolts and adjust R2 of the Pre-Amplifier Assembly (Figure 3-7) until the numerical value displayed in the readout is equal to the voltage of the voltage standard. This step completes the calibration of the Pre-Amplifier Assembly.

OHMS CONVERTER CALIBRATION

ADDITIONAL EQUIPMENT REQUIRED

1. An ohms standard accurate to 0.01%. The values required are called out in each calibrating step.

INITIAL PREPARATION

1. Ensure that the instrument is properly calibrated in the DC voltage measurement function.

2. Either perform steps 1 thru 6 under Calibration with Drawers in Outer Chassis or steps 1 thru 3 under Calibration with Drawers Removed.

PROCEDURE

1. Place the SCAN MODE switch in the INT. position.

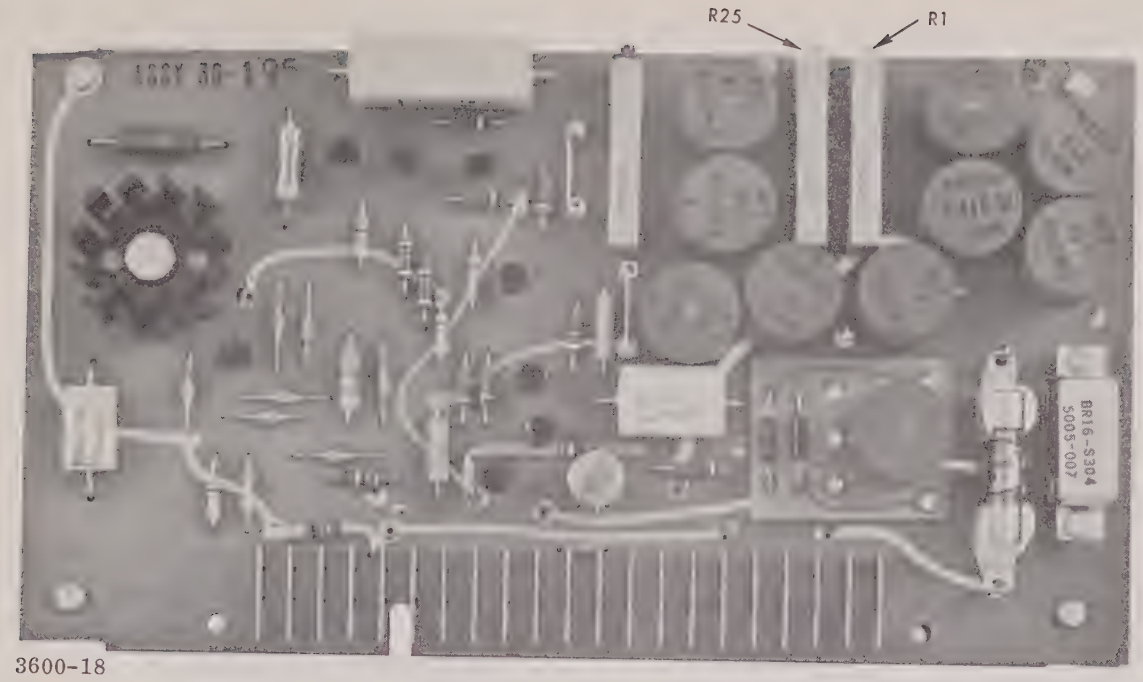


Figure 3-6. Ratio Reference Assembly Adjustment Points

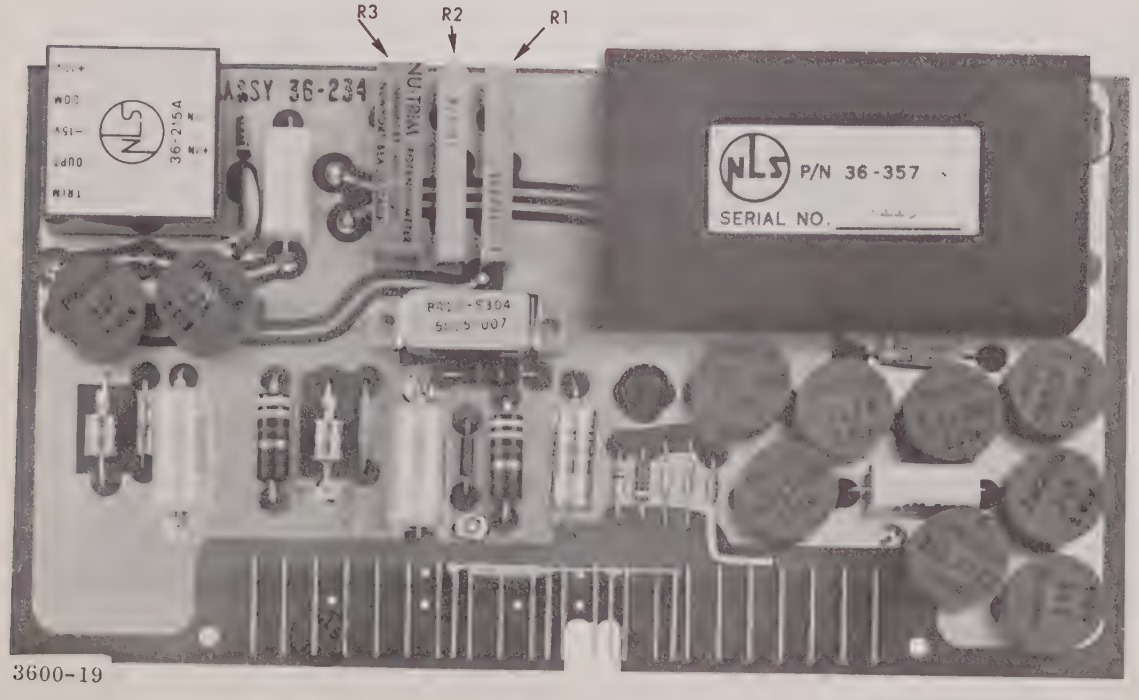


Figure 3-7. Pre-Amplifier Assembly Adjustment Points

2. Turn the THRESHOLD potentiometer adjustment fully counterclockwise.

3. Place the FUNCTION switch in the KΩ position.

4. Place the FILTER switch in the OUT position.

5. Place the RANGE switch in 1K range.

NOTE

The 1K range is displayed on the front panel as the numeral 1 since the ohms ranges are in KΩ. Also, the numerals 10 and 100 represent the 10K and 100K ranges respectively and the 1000 and 10000 displays represent the 1 MEG and 10 MEG ranges respectively.

6. Connect the red, yellow, black and green leads of the DVM together. Adjust the KΩ/MV OFFSET potentiometer until the readout displays 00. 0000.

7. Connect the leads of the DVM input cable to the ohms standard as shown in Figure 3-8.

8. Apply approximately .90000KΩ and adjust R1 of the Ohms Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the ohmic value applied.

9. Place RANGE switch in the 10K range. Apply approximately 9.0000KΩ and adjust R2 of the Ohms Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the ohmic value applied.

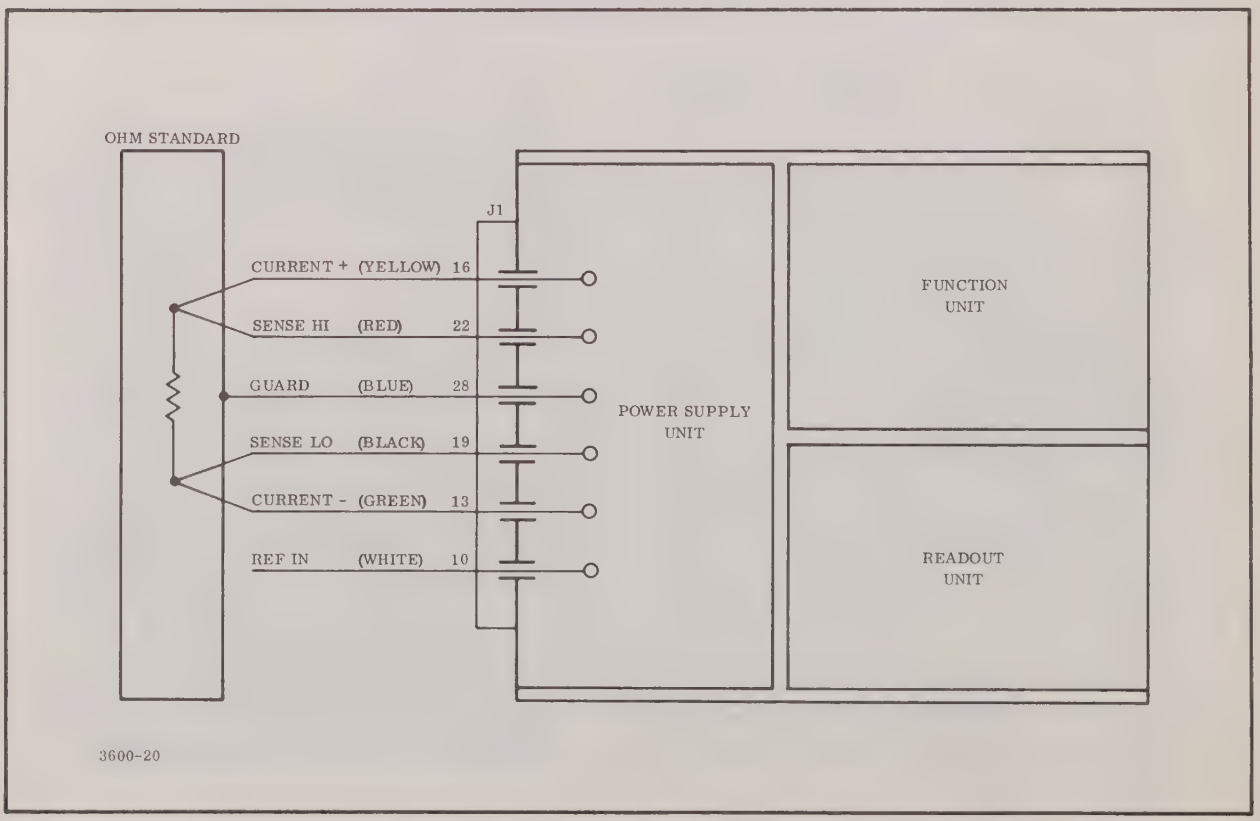


Figure 3-8. Ohms Converter Assembly Calibration Cable Connections

10. Place RANGE switch in the 100K range. Apply approximately 90.000KΩ and adjust R3 of the Ohms Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the ohmic value applied.

11. Place RANGE switch in the 1 MEG range. Apply approximately 900.00KΩ and adjust R4 of the Ohms Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the ohmic value applied.

12. Place RANGE switch in the 10 MEG range. Apply approximately 9000.0KΩ and adjust R5 of the Ohms Converter Assembly (Figure 3-9) until the numerical value displayed in the readout is equal to the ohmic value applied.

NOTE

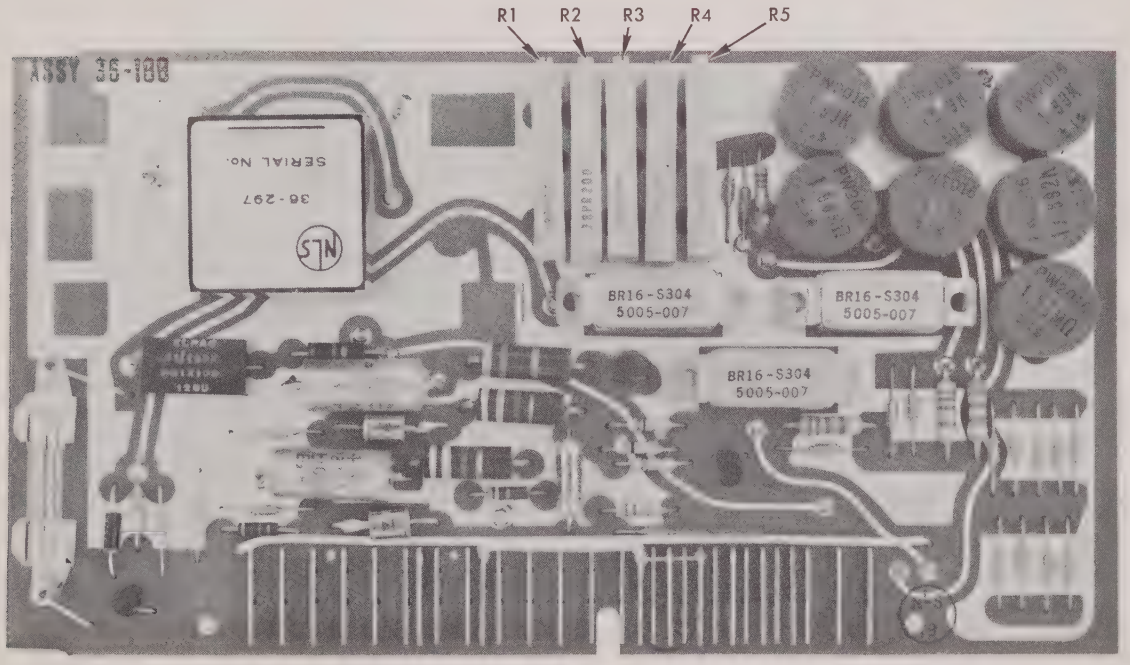
When measuring high value resistors, it may be necessary to connect the guard (blue lead) to earth ground and/or turn the filter switch to the IN position.

Step 12 completes the calibration of the Ohms Converter Assembly.

AC CONVERTER CALIBRATION

ADDITIONAL EQUIPMENT REQUIRED

1. An Audio Voltage Standard between 1 volt, 200 Hz - 10 KHz and 500 volts, 200 Hz - 10 KHz.



3600-21

Figure 3-9. Ohms Converter Assembly Adjustment Points

INITIAL PREPARATION

1. Ensure that the instrument is properly calibrated in the DC voltage measurement function.

2. Either perform steps 1 thru 6 under Calibration with Drawers in Outer Chassis or steps 1 thru 3 under Calibration with Drawers Removed.

PROCEDURE

1. Place the SCAN MODE switch in the INT. position.

2. Place the FUNCTION switch in the AC position.

3. Place the FILTER switch in the OUT position.

4. Place the RANGE switch in the 1 position.

5. Turn the THRESHOLD potentiometer adjustment fully counterclockwise.

6. Connect the red, black and blue leads of the DVM input cable together. Adjust the AC/MV OFFSET potentiometer until the readout displays 00. 0000.

7. Connect the leads of the DVM input cable to the audio voltage standard as shown in Figure 3-10.

8. Apply approximately .90000 volts, 200 Hz and adjust R4 of the AC Converter Assembly (Figure 3-11) until the numerical value displayed in the readout is equal to the voltage applied.

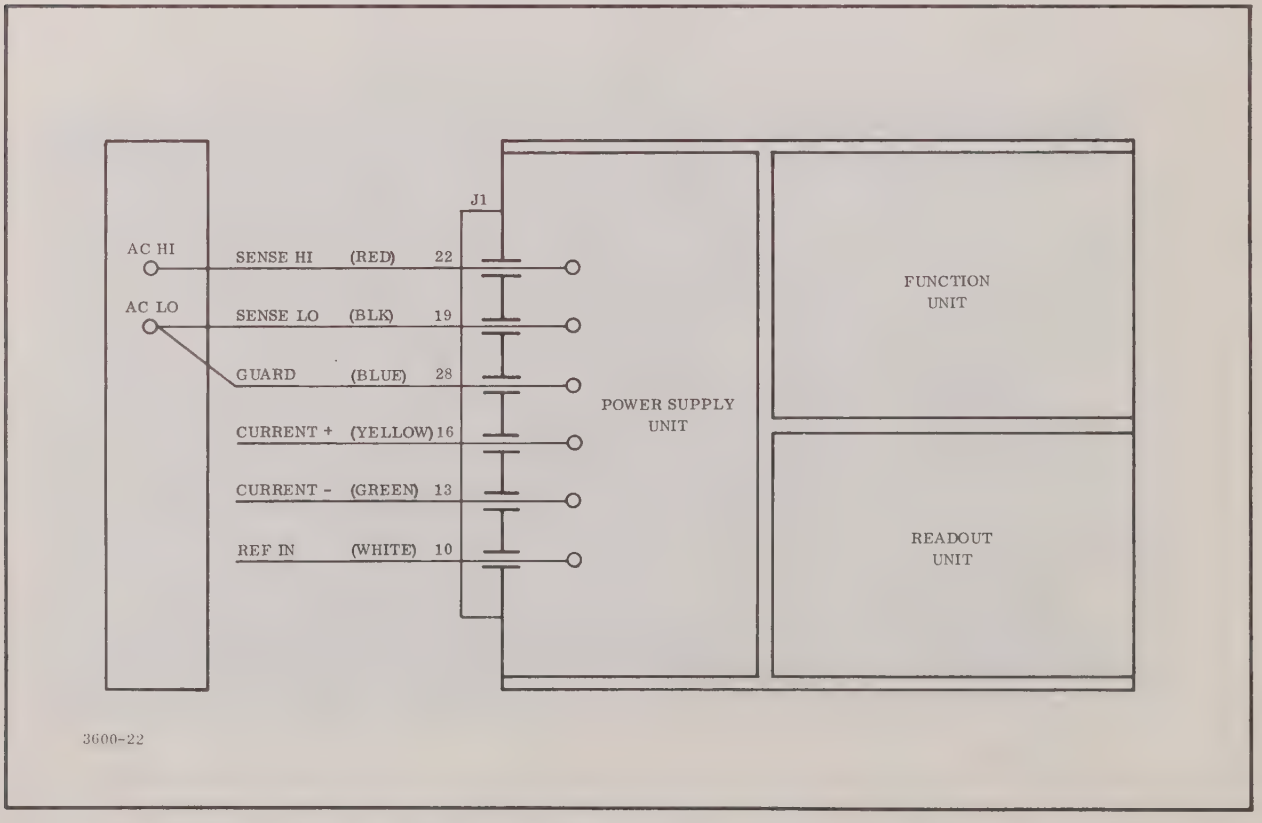


Figure 3-10. AC Converter Assembly Calibration Cable Connections

9. Apply approximately .90000 volts, 10 KHz and adjust C4 of the AC Converter Assembly (Figure 3-11) until the numerical value displayed in the readout is equal to the voltage applied.

10. Place the RANGE switch in the 10 position. Apply approximately 9.0000 volts, 200 Hz and adjust R3 of the AC Converter Assembly (Figure 3-11) until the numerical value displayed in the readout is equal to the voltage applied.

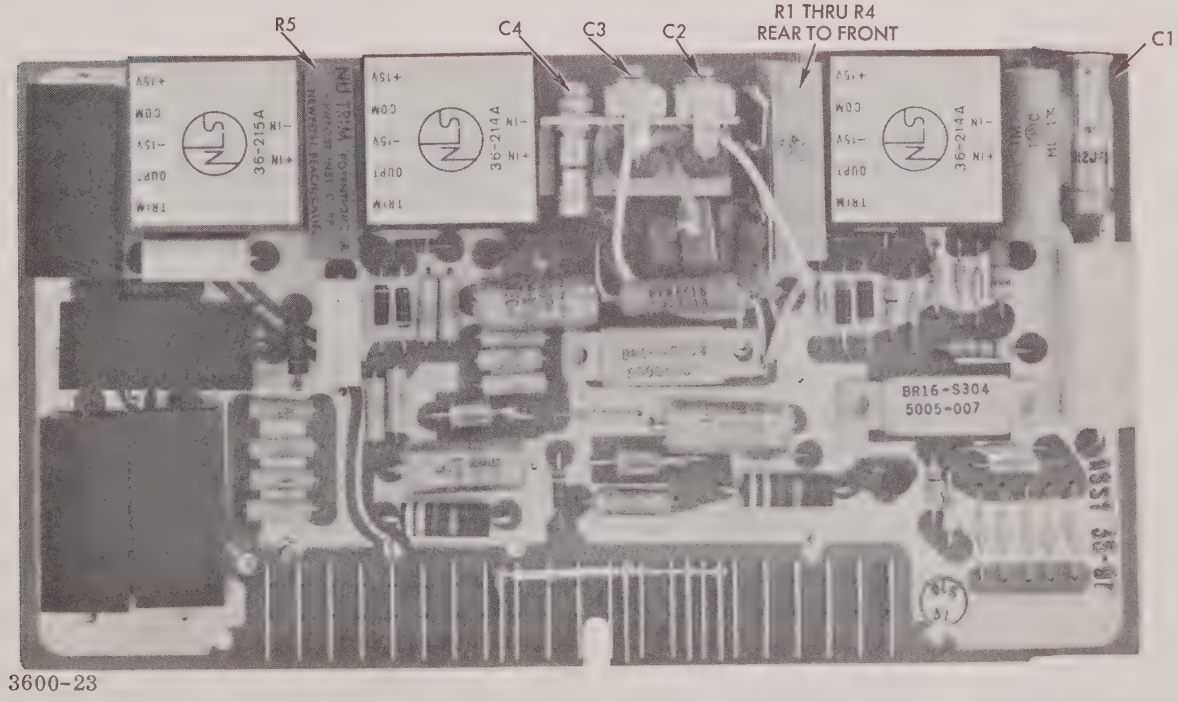
11. Apply approximately 9.0000 volts, 10 KHz and adjust C3 of the AC Converter Assembly (Figure 3-11) until the numerical value displayed in the readout is equal to the voltage applied.

WARNING

Use extreme caution in performing the following steps as dangerously high voltages will be employed.

12. Place the RANGE switch in the 100 position. Apply approximately 90.000 volts, 200 Hz and adjust R2 of the AC Converter Assembly (Figure 3-11) until the numerical value displayed in the readout is equal to the voltage applied.

13. Apply approximately 90.000 volts, 10 KHz and adjust C2 of the AC Converter Assembly (Figure 3-11) until the numerical value displayed in the readout is equal to the voltage applied.



3600-23

Figure 3-11. AC Converter Assembly Adjustment Points

CAUTION

Do not apply more than 500 VAC - damage to the AC Converter Assembly may result.

14. Place the RANGE switch in the 1000 position. Apply approximately 450.000 volts, 200 Hz and adjust R1 of the AC Converter Assembly (Figure 3-11) until the numerical value displayed in the readout is equal to the voltage applied.

15. Apply approximately 450.00 volts, 10 KHz and adjust C1 of the AC Converter Assembly (Figure 3-11) until the numerical value displayed in the readout is equal to the voltage applied. This step completes the calibration of the AC Converter Assembly.

CHAPTER IV

MAINTENANCE

In the Series X-1 Digital Voltmeter, virtually all circuit components are assembled on plug-in modules. Thus maintenance problems are simplified to the point where the instrument can be kept operating without the need for highly trained maintenance personnel. Because of this plug-in design, down-time is held to a minimum; the unit can be kept operating in locations from which it would be impractical or inconvenient to send the instrument to a repair facility or to the manufacturer. Only a very few minutes are needed to replace all of the plug-in boards. By using trial-and-error techniques the instrument can be rapidly returned to service, and the defective module repaired at a later date.

For a general understanding of the principles of operation of the Series X-1 DVM, refer to Figures 4-1 thru 4-11. For a more detailed analysis, refer to the Schematic and wiring diagrams at the end of this manual.

In order to pursue the plug-in philosophy to the fullest, spare modules as listed in Section V, Recommended Spare Parts List, should be kept in stock.

If it is desired to measure voltages and check waveforms on a particular plug-in module, a 41-pin extension board will be required to raise the board so that pin contacts become accessible. These boards, NLS part number 1009-41, may be ordered from any NLS representative or from the NLS Main Office in Del Mar, California.

DIGITAL READOUT MAINTENANCE

The digital readout modules do not ordinarily require maintenance other than lamp bulb replacement and an occasional cleaning. Most readouts have decals on the module cover, on the top and bottom of each readout, to show which contact is providing the signal for each digit or symbol. If decals are not provided, see Figure 4-12 for information to locate each digit or symbol contact point.

LAMP BULB REPLACEMENT

When it is determined that a digit or symbol is not illuminating within a specific readout display, the lamp bulb may be replaced by performing the following steps:

1. Remove the DIGITAL OUTPUT or POWER knob from the readout panel.

   CAUTION

   Do not disconnect drawer assemblies with power on. Damage to plug-in modules may result.

2. Loosen (turn counterclockwise) the two fasteners on the Readout Unit Assembly.
3. Pull drawer slightly forward and then remove four screws attaching readout panel to readout drawer assembly and remove front panel.
4. Gently withdraw readout module with defective bulb from readout plug-in board (Figure 4-13).

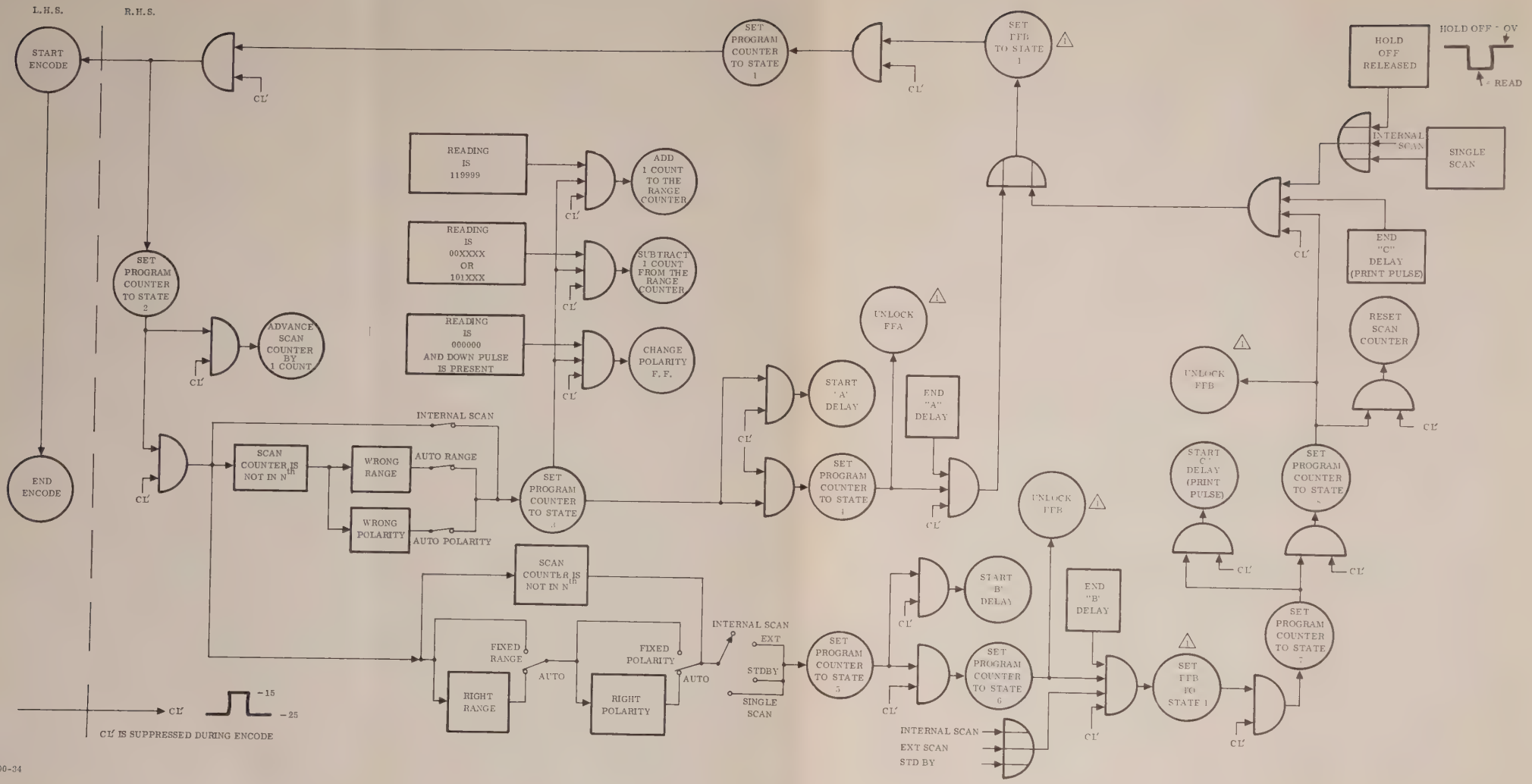
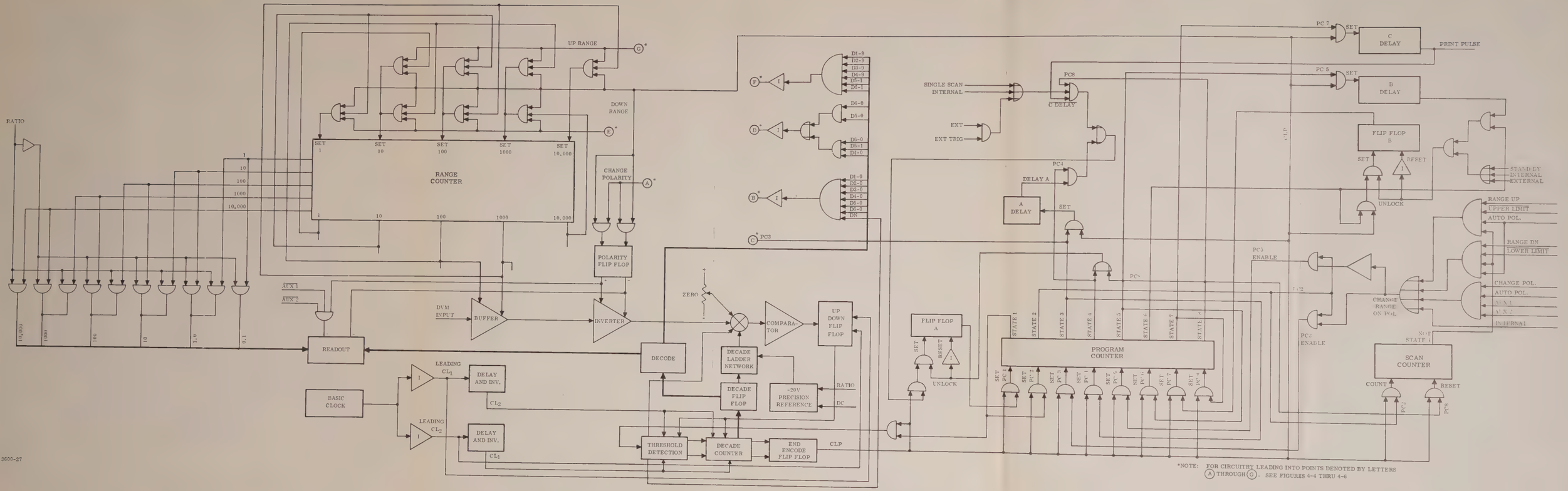
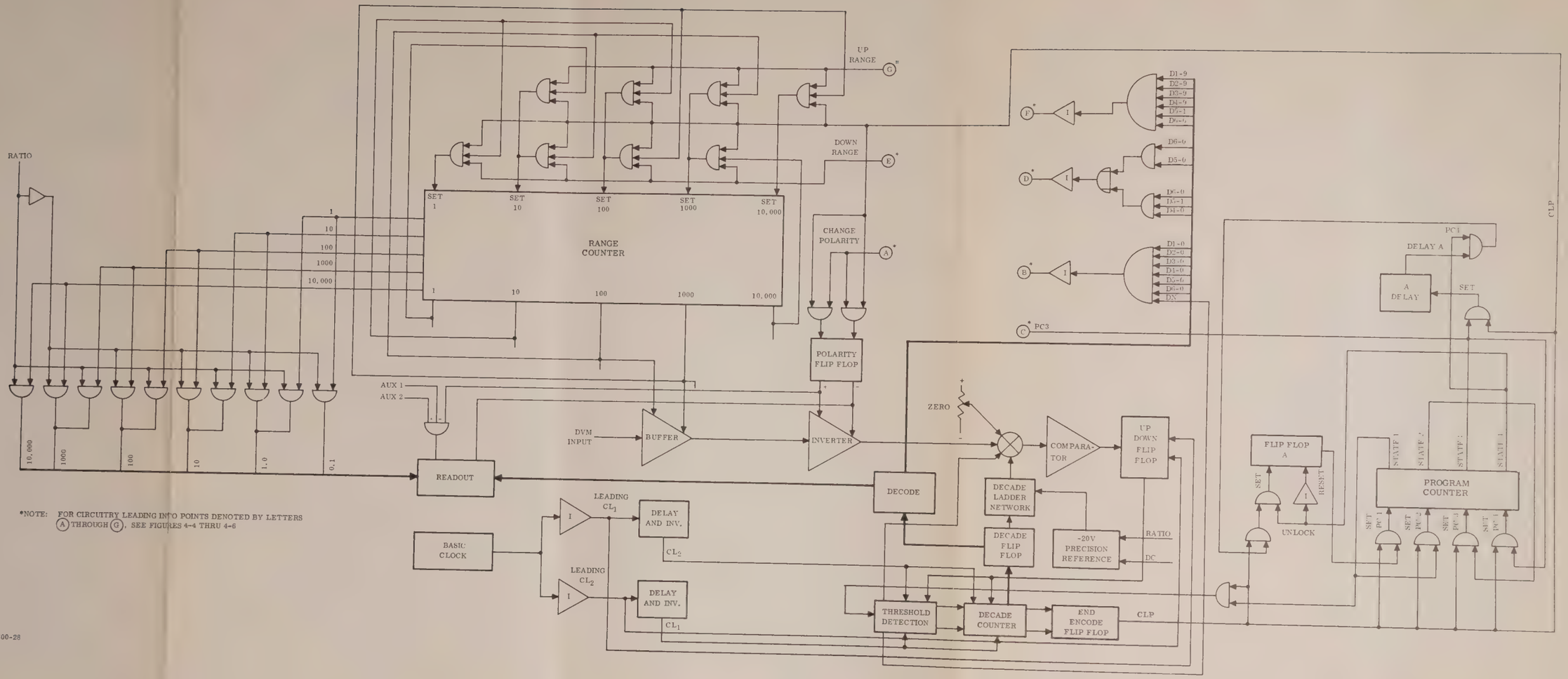


Figure 4-1. Series X-1 DVM Flow Diagram



*NOTE: FOR CIRCUITRY LEADING INTO POINTS DENOTED BY LETTERS (A) THROUGH (G), SEE FIGURES 4-4 THRU 4-6

Figure 4-2. Block Diagram X-1 DVM with Printout Function



*NOTE: FOR CIRCUITRY LEADING INTO POINTS DENOTED BY LETTERS (A) THROUGH (G), SEE FIGURES 4-4 THRU 4-6

3600-28

Figure 4-3. Block Diagram X-1 DVM without Printout Function

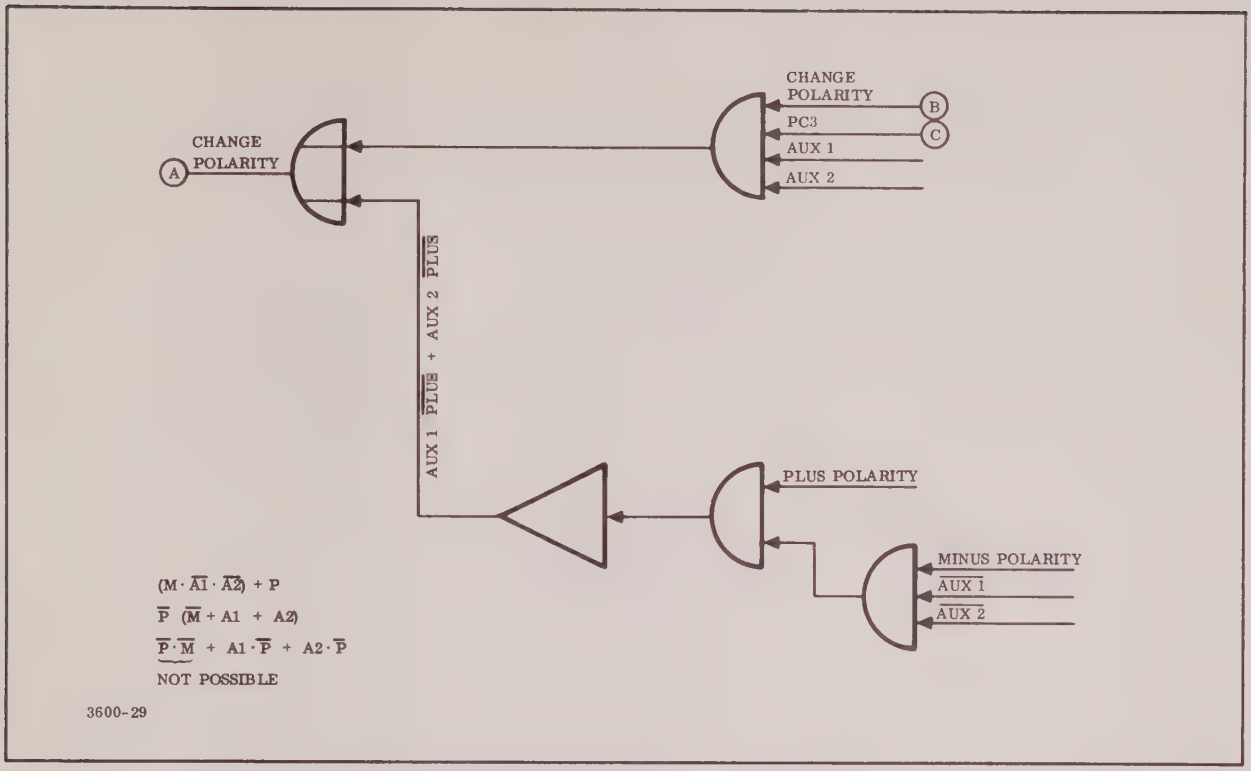


Figure 4-4. Polarity Gate

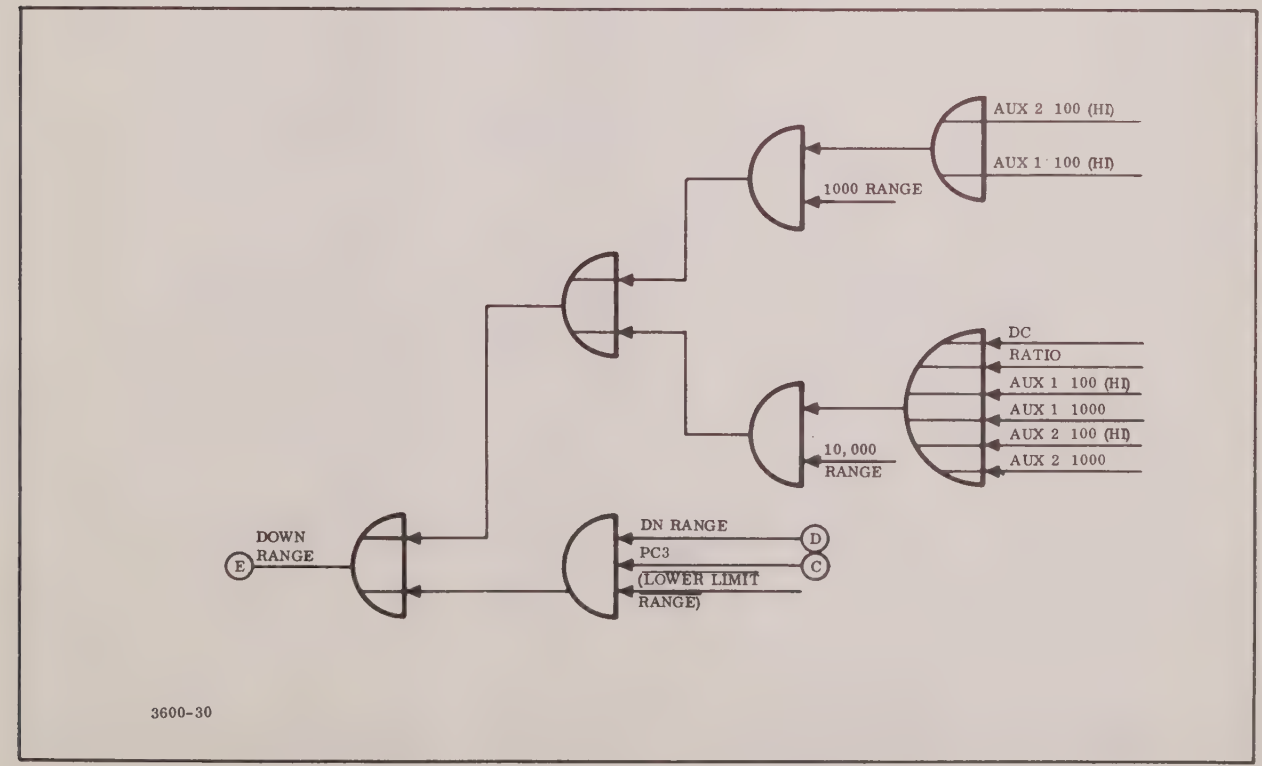


Figure 4-5. Forbidden Upper Range Gate

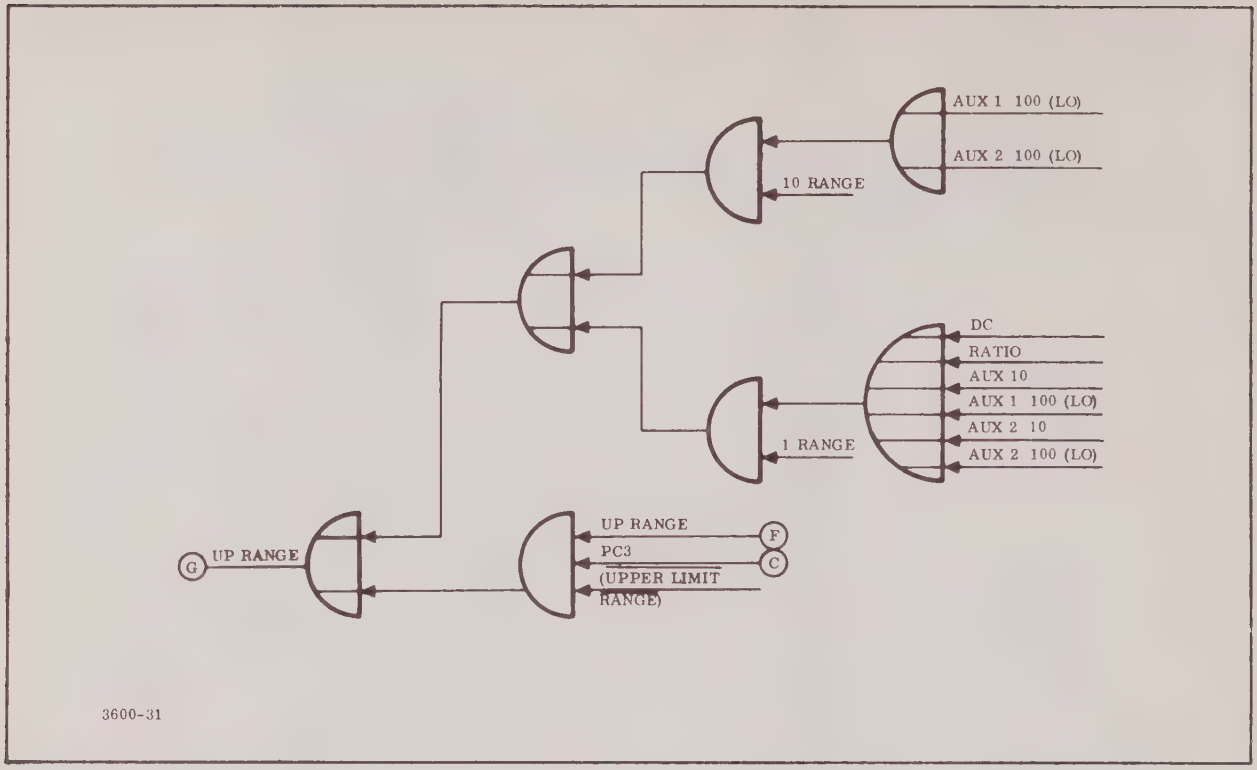


Figure 4-6. Forbidden Lower Range Gate

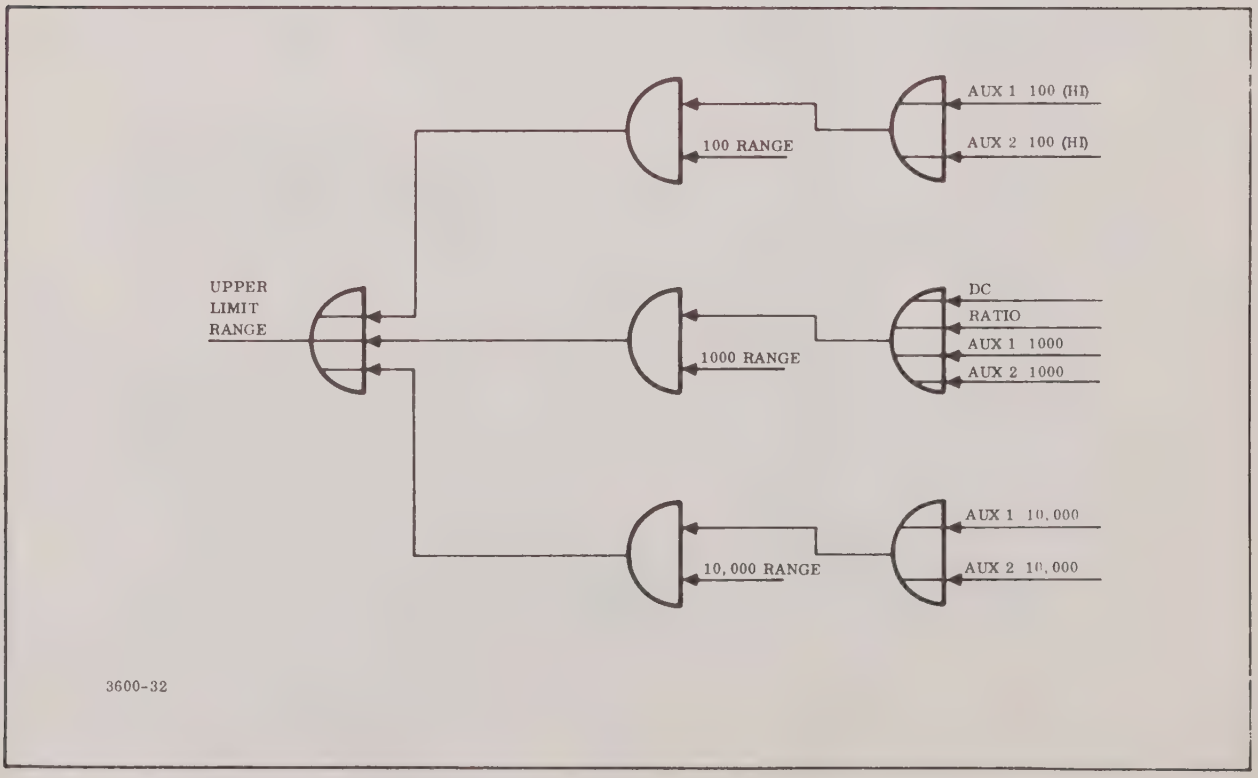


Figure 4-7. Upper Limit Range Gate

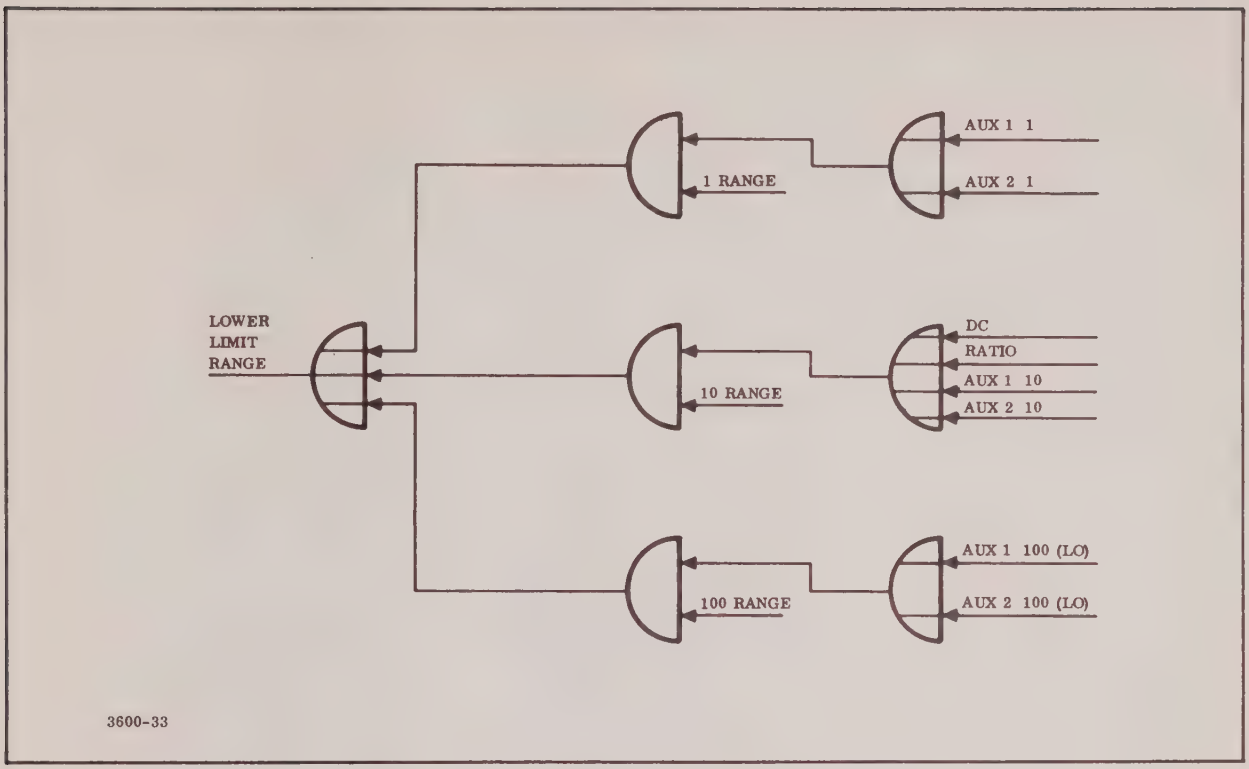


Figure 4-8. Lower Limit Range

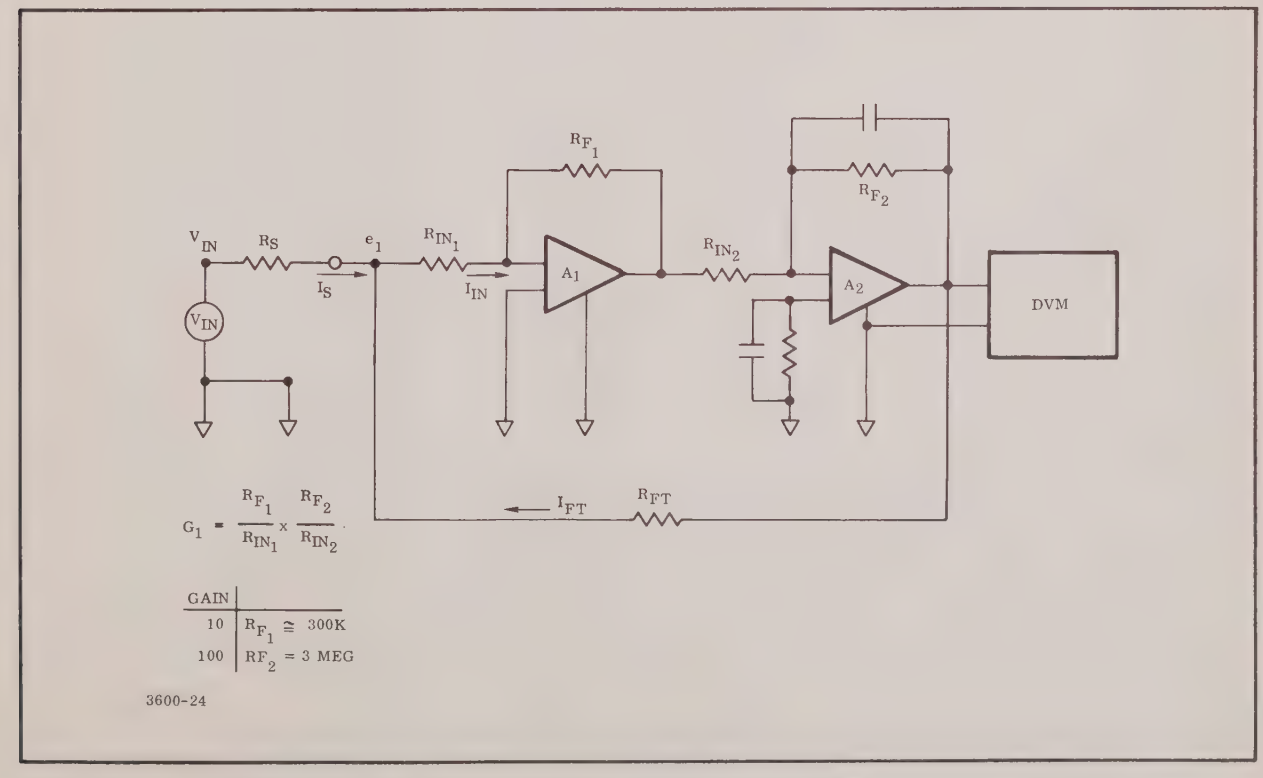
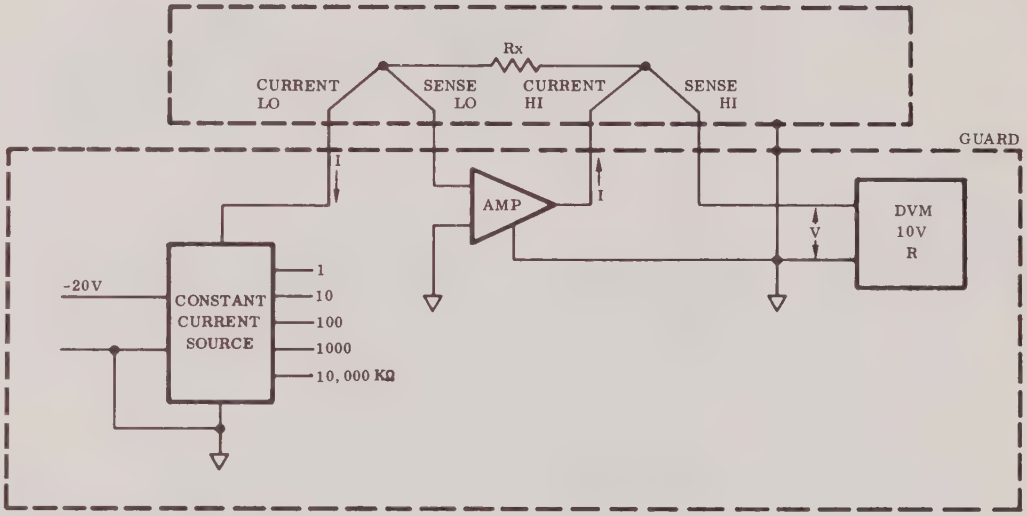


Figure 4-9. Simplified Diagram Pre-Amplifier Assembly



V = I R_X (FULL SCALE) = 10 VOLTS

R_X	I
1K	10MA
10K	1MA
100K	100μA
1000K	10μA
10,000K	1μA

3600-25

Figure 4-10. Simplified Diagram Ohms Converter Assembly

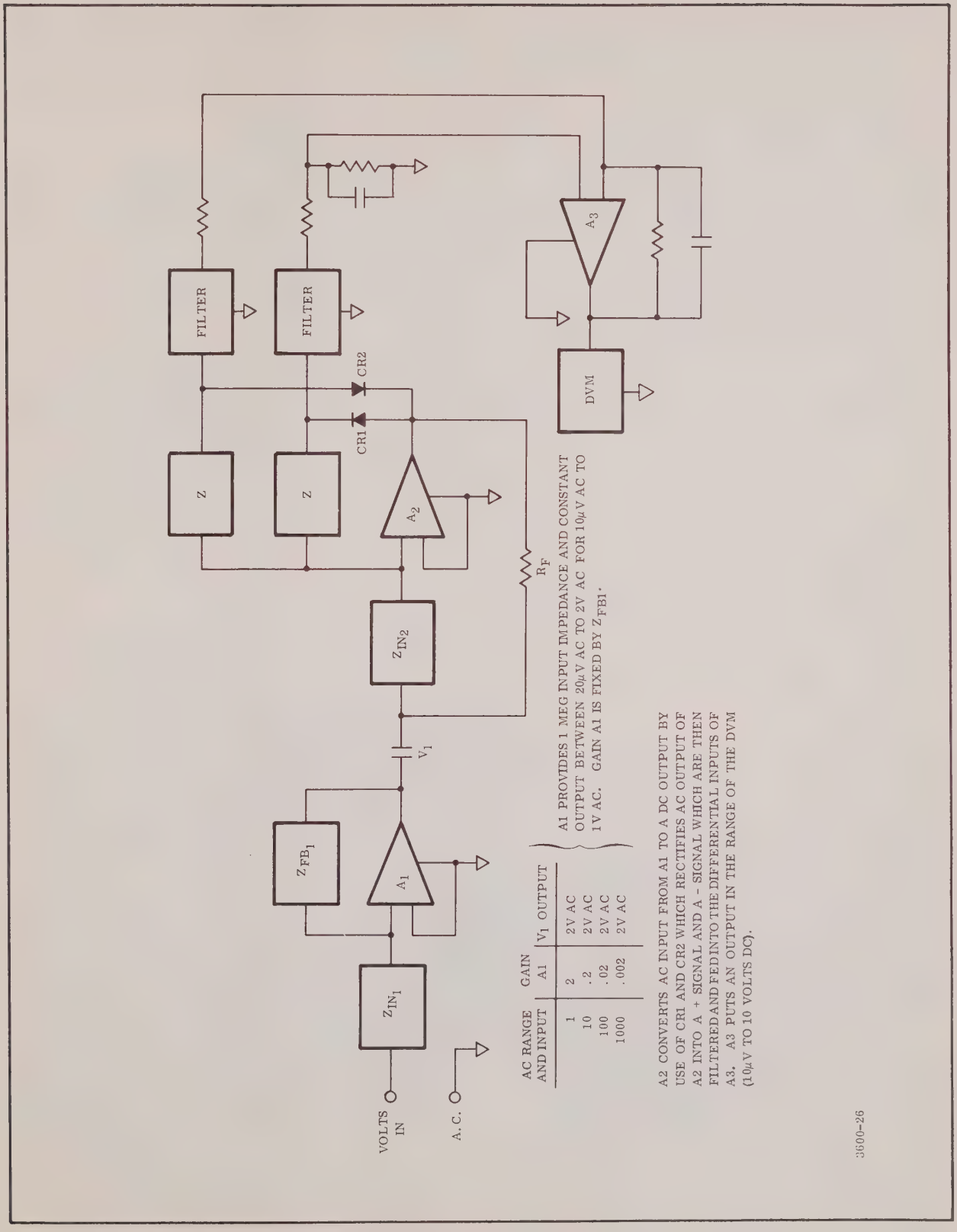

VOLTS IN
A.C.
Z_{IN_1}
Z_{FB_1}
A_1
V_1
Z_{IN_2}
A_2
R_F
Z
Z
CR1
CR2
FILTER
FILTER
A_3
DVM
AC RANGE AND INPUT
GAIN A1
V_1 OUTPUT
1 2 2V AC
10 .2 2V AC
100 .02 2V AC
1000 .002 2V AC
A1 PROVIDES 1 MEG INPUT IMPEDANCE AND CONSTANT OUTPUT BETWEEN 20μV AC TO 2V AC FOR 10μV AC TO 1V AC. GAIN A1 IS FIXED BY Z_{FB1}.
A2 CONVERTS AC INPUT FROM A1 TO A DC OUTPUT BY USE OF CR1 AND CR2 WHICH RECTIFIES AC OUTPUT OF A2 INTO A + SIGNAL AND A - SIGNAL WHICH ARE THEN FILTERED AND FED INTO THE DIFFERENTIAL INPUTS OF A3. A3 PUTS AN OUTPUT IN THE RANGE OF THE DVM (10μV TO 10 VOLTS DC).
3600-26

Figure 4-11. Simplified Diagram AC Converter Assembly

5. Locate correct contact point for defective bulb either by noting decal on readout or by referring to Figure 4-12.

6. Remove cover from readout by removing the two attaching screws (Figure 4-14).

7. Gently withdraw the lamp board assembly away from the lamp block within the readout (Figure 4-15).

8. Unsolder defective bulb and replace it with a functioning T-1-3/4 14-volt bulb.

9. Reassemble readout and replace readout, front panel and knob in reverse order of removal.

10. If for any reason the Polaroid filter is removed from between the control identification panel and the facade, care should be taken to re-install the filter so that the polarizing action is correct. Look through the filter at a piece of shiny metal, such as the chrome rim of a wrist-watch. If the metal shows a markedly violet cast, then the filter front is the surface closest to the eye.

READOUT WINDOW CLEANING

Under extremely adverse dust or humidity conditions, the individual readout windows may require cleaning. If accumulated dust particles are likely to be unusually abrasive, a camel-hair brush or artist's sable brush should first be used to remove loose dust particles. The windows may then be cleaned with commercial isopropyl alcohol and lint-free paper, such as Kimwipes 900-L, manufactured by Kimberly-Clark, Neenah, Wisconsin. The windows may also be cleaned if they are dipped in alcohol and then blown dry with compressed air.

To remove the windows from the readout, perform the following steps:

1. Perform steps 1, 2, and 3 under Lamp Bulb Replacement.

2. Perform steps 6 and 7 (both top and bottom lamp boards) under Lamp Bulb Replacement for each readout to be cleaned.

3. Remove each two sets of lamp block attaching screws.

4. Gently press against one lamp block until the other lamp block may be removed and until windows can be withdrawn with finger-tip pressure.

5. Clean the windows as set forth above.

NOTE

It is well to be systematic about this operation so as to avoid replacing the windows in improper order. Care should be taken to avoid replacing the windows backwards; this type of error is most likely to occur with windows marked 1, 0, 6, 8, 9, + or -. Note that the engraved side always faces to the rear of the readout.

6. Stack the windows in proper order and press them together with mild fingertip pressure. Avoid fingerprints on the windows. After ensuring that the numerals are right side up and that the engraved side faces the rear of the readout, gently slip the windows into the cover.

7. Perform step 9 and note step 10 under Lamp Bulb Replacement.

H.P. 2140-0037
" " -0038

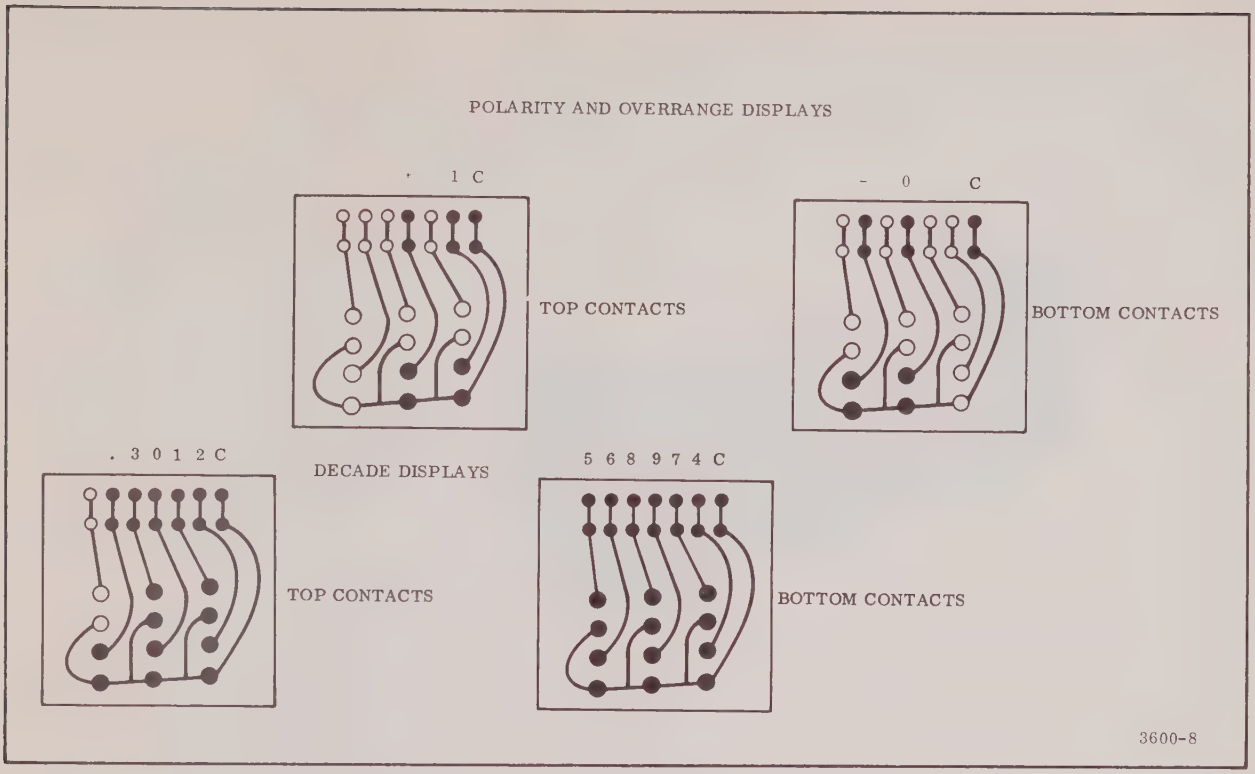


Figure 4-12. Lamp Bulb Contact Points

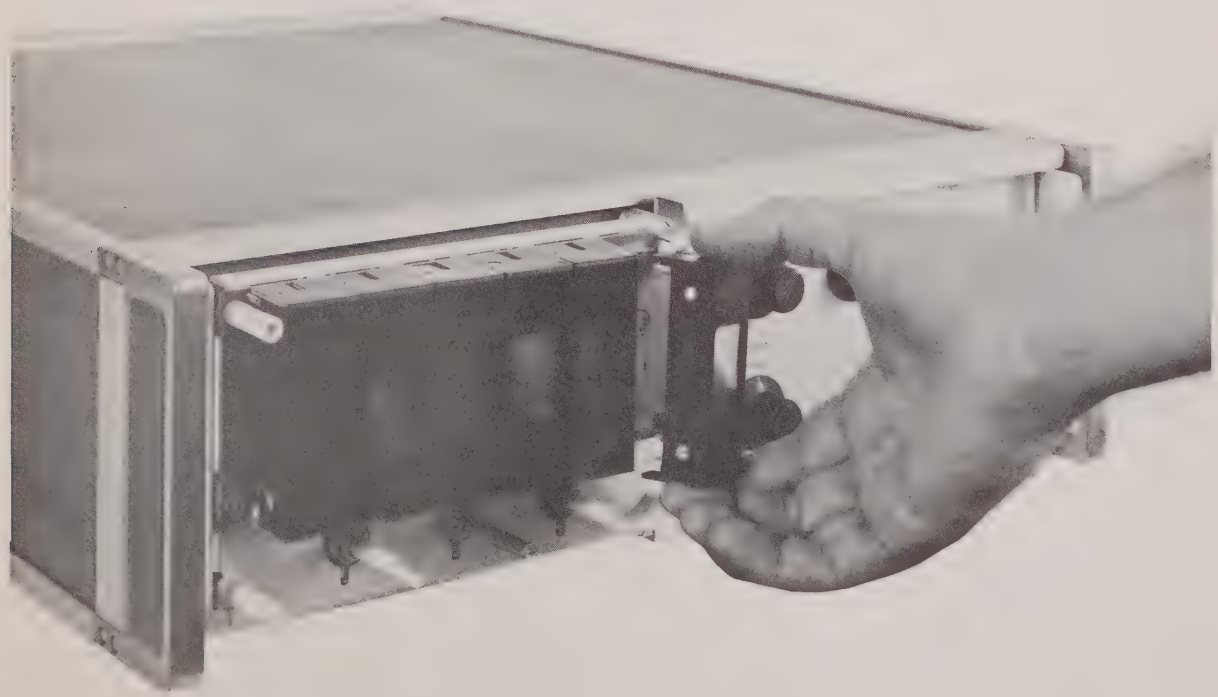


Figure 4-13. Readout Module Removal

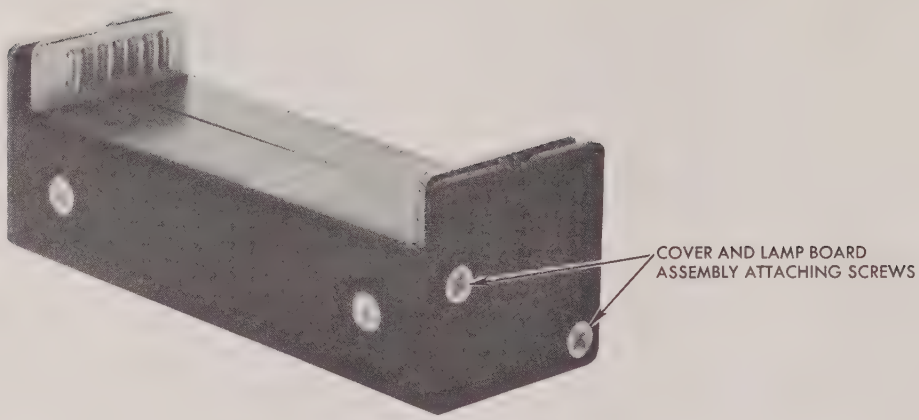


Figure 4-14. Readout Module

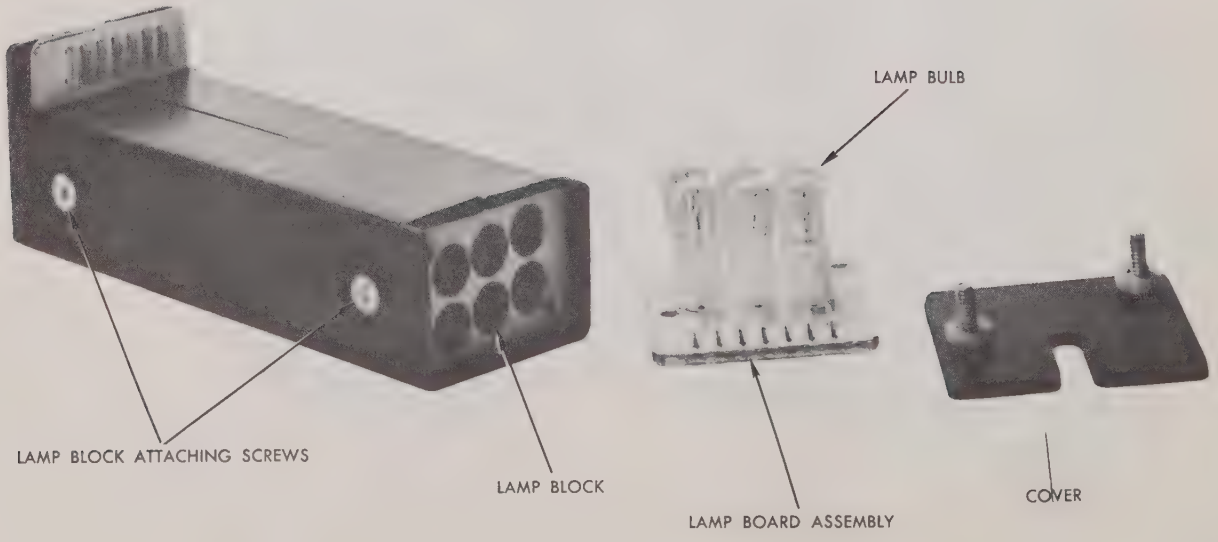


Figure 4-15. Readout Module with Cover and Lamp Board Assembly Removed

CHAPTER V

RECOMMENDED SPARE PARTS LIST

PART NO.	DESCRIPTION	QUANTITY
36-8	Decade Counter Assembly	1
36-11	Reference Assembly	1
36-14	Decade (1-4) Assembly	1
36-16	Decade (5) Assembly	1
36-26	Comparator Assembly	1
36-43	Inverter Assembly	1
36-67	Decode Assembly	1
36-73	Threshold and Clock Assembly	1
36-179	Transfer Board No. 1 Assembly (DVM P/N's 36-468 & 36-472 only)	1
36-185	Transfer Board No. 3 Assembly (DVM P/N's 36-468 & 36-472 only)	1
36-191	Function Relay Assembly	1
36-495	Rectifier Assembly (DVM P/N's 36-388 & 36-468 only)	1
36-249	Program Counter Assembly	1
36-266	Regulator Assembly	1
36-269	Polarity Flip-Flop Assembly	1
36-272	Range Counter Assembly	1
36-275	Scan Counter Assembly (DVM P/N's 36-472 & 36-488 only)	1
36-296	Filter Assembly	1
36-314	Buffer Assembly	1
36-320	Range Limit Logic Assembly	1
36-324	Range Decision Assembly	1
36-485	Rectifier & Power Relay Assembly (DVM P/N's 36-382 & 36-472 only)	1
36-488	Transfer Board No. 2 Assembly (DVM P/N's 36-468 & 36-472 only)	1
36-494	Scan Control Assembly (DVM P/N's 36-382 & 36-388 only)	1
36-555	Buffer Assembly (S/N 331 and on)	1
1N4720	Diode	1
4-10-59	Readout Module (Decade)	1
4-10-98	Readout Module (Polarity and Over-range)	1
4-19-1	Bulb, Lamp	12
313001	Fuse, 3AG1A, Slo-Blo	10
WHISPER	Fan, Rotron	1
1009-41	Extension Board	1
D-224	Transformer	1
500-1034-01	Capacitor, 6000 MFD, 20V	1
500-1058-01	Capacitor, 1900 MFD, 50V	1
500-1074-01	Capacitor, 725 MFD, 100V	1

APPENDIX

SHIPPING INSTRUCTIONS

Depending upon location, the choice of carrier will vary. Never ship an instrument to us without having received shipping instructions. If requested, an estimate of charges can be made before work begins.

Be certain to pack the instrument carefully; while an outer and inner box, separated by two or three inches of excelsior is desirable, the instrument can be placed into a single container provided it is so packed that it will not shift about. As with the double box method, use two or three inches of shock-absorbent packing materials. The instrument itself should be first wrapped in heavy paper so as to keep excelsior or other particles from entering the instrument's louvers. If the original shipping container is in good condition, it may be used.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it does not operate or is damaged, a claim should be made with the carrier. The claim agent should receive a full report of damage, and this report sent to Non-Linear Systems, Inc. After receiving such a report we will advise you of the disposition of the instrument and arrange for its repair or replacement. Be certain to include model and serial number when corresponding.

GLOSSARY OF FUNCTION DESIGNATIONS ON SCHEMATIC DIAGRAMS

Decade Counter Assembly - 36-8

(D) (CL2) - Down signal and clock pulse
$CL1_2$ - Clock pulse
$CL2_1$ - Clock pulse
Z DECS - Zero decades
(D) (CL1) - Down signal and clock pulse
$CL1_1$ - Clock pulse
Z 5-4 - Zero the 4 bit in the 5th Decade (Typical)
S 5-4* - Set the 4* bit in the 5th Decade (Typical)
$CL2_2$ - Clock pulse

Comparator Assembly - 36-26

(D) CL1 - Down signal and clock pulse
(D) CL2 - Down signal and clock pulse
D. A. C. - Digital-to-analog converter

Inverter Assembly - 36-43

L = MINUS - Low signal is minus polarity
L = PLUS - Low signal is plus polarity

Decode Assembly - 36-67

L = 1 - Low signal = 1 bit
H = 1 - High signal = 1 bit
L = 2• 2* (4*) - Low signal = 2 & 2* bit (1-4 decades) and 2 & 4* bit in 5th decade
H = 2• 4 - High signal = 2 & 4 bit

Threshold and Clock Assembly - 36-73

D-CL2 - Down signal and clock pulse
$CL2_2$ - Clock pulse
$DL2_1$ - Clock pulse
D-CL_1 - Down signal and clock pulse
$CL1_2$ - Clock pulse
$CL1_1$ - Clock pulse
CL_3 - Clock pulse
CL_2 - Clock pulse
CL_1 - Clock pulse

L = UP - Low signal = up pulse
L = DN - Low signal = down pulse
H = DN - High signal = down pulse
$\overline{\text{L = ENCODE}}$ - Low signal = not encode
L = ENCODE - Low signal = encode

Transfer Relay Assembly #1 - 36-179

D4-8 - Decade 4, numeral 8 (Typical)
P. S. G. - Power supply ground
C. C. - Contact closure

Transfer Relay Assembly #2 - 36-182

D4-8 - Decade 4, numeral 8 (Typical)
B. C. D. -4 - Binary numeral 4 (Typical)

Program Counter Assembly - 36-249

CL_P - Clock pulse to program counter

Regulator Assembly - 36-266

P. S. G. - Power supply ground

Polarity Flip-Flop Logic Assembly - 36-269

PC_7 - Program counter state 7
L = CHANGE POLARITY - Low signal = polarity change
PC_3 - Program counter state 3
H = RATIO - High signal = ratio
CL_3 - Clock pulse
L = PC_3 - Signal is low with program counter in state 3

Range Counter Assembly - 36-272

CL_P - Clock pulse to program counter
H = UP RANGE - High signal is up range pulse
H = DN RANGE - High signal is down range pulse

Scan Counter Assembly - 36-275

CL_P - Clock pulse to program counter
H = AUTO RANGE - High signal = auto range
L = RANGE UP - Low signal = up range pulse

L = 1000V RANGE - Low signal = 1000V range
L = RANGE DN - Low signal = down range pulse
L = 10V RANGE - Low signal = 10V range

Range Limit Logic Assembly - 36-320

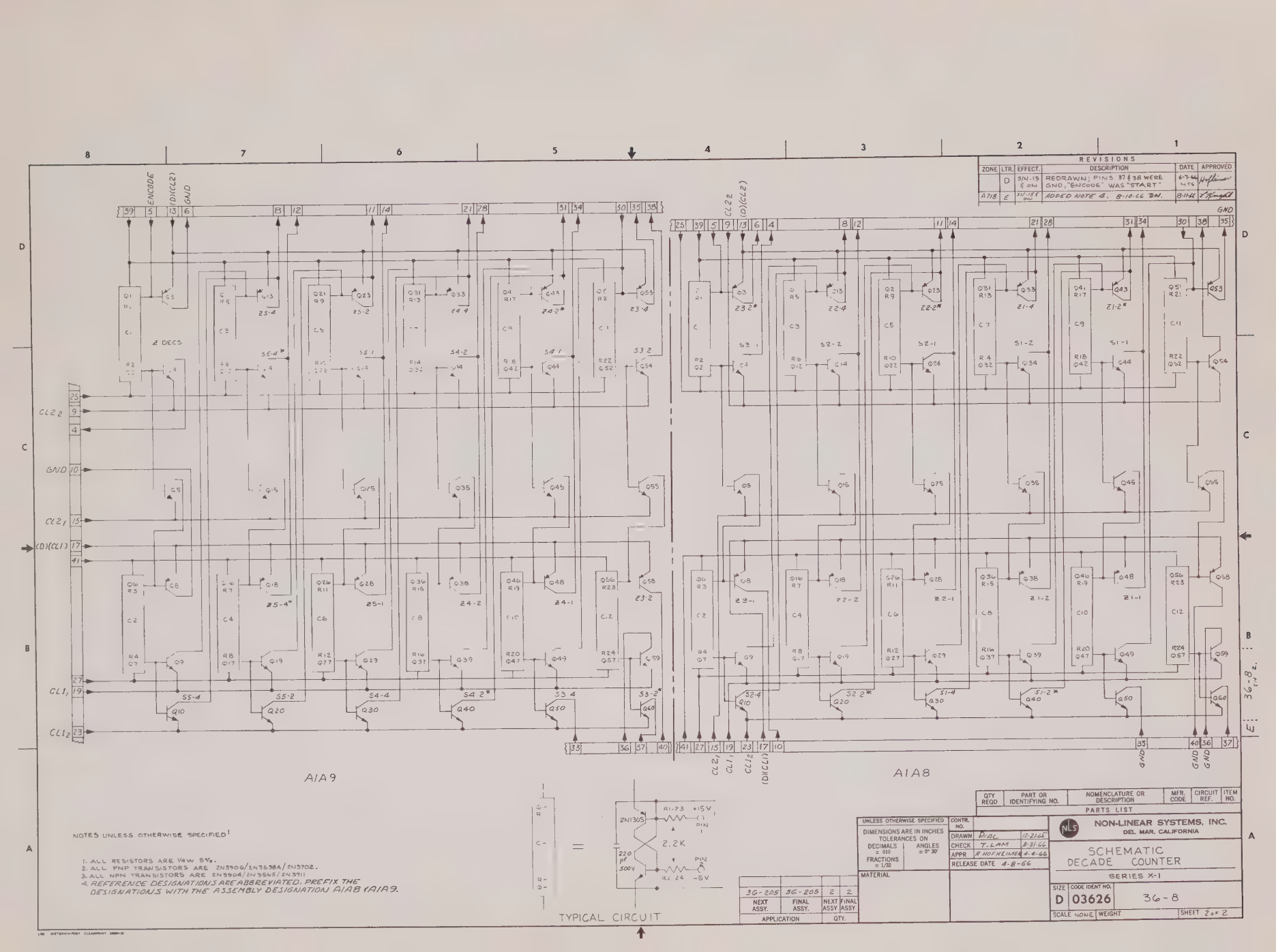
H = LOWER LIMIT RANGE - High signal = lower limit range
H = UPPER LIMIT RANGE - High signal = upper limit range
H = RANGE UP - High signal = up range pulse
H = RANGE DOWN - High signal = down range pulse
L = RANGE UP - Low signal = up range pulse
L = PC_3 - Signal is low with program counter in state 3
L = DOWN RANGE - Low signal = down range pulse

Range Decision Logic Assembly - 36-324

L = $(2 \cdot 4^*)_5$ - Low signal = 2 & 4* bit in 5th decade
L = $(1)_5$ - Low signal = 1 bit in 5th decade
H = DN = High signal = down pulse
L = 0_3 - Have low signal with number zero lighted in 3rd decade
L = 0_2 - Have low signal with number zero lighted in 2nd decade
L = 0_1 - Have low signal with number zero lighted in 1st decade
L = 0_4 - Have low signal with number zero lighted in 4th decade
H = $(2 \cdot 4)_5$ - Have high signal with 2 & 4 bit in 5th decade
H = $(1)_5$ - Have high signal with 1 bit in 5th decade
L = CHANGE POL. - Low signal = Polarity change
L = 9_4 - Have low signal with number nine lighted in 4th decade
L = 9_3 - Have low signal with number nine lighted in 3rd decade
L = 9_2 - Have low signal with number nine lighted in 2nd decade
L = 9_1 - Have low signal with number nine lighted in 1st decade
L = RANGE DN - Low signal = Down range pulse
L = RANGE UP - Low signal = Up range pulse
CL_3 - Clock Pulse

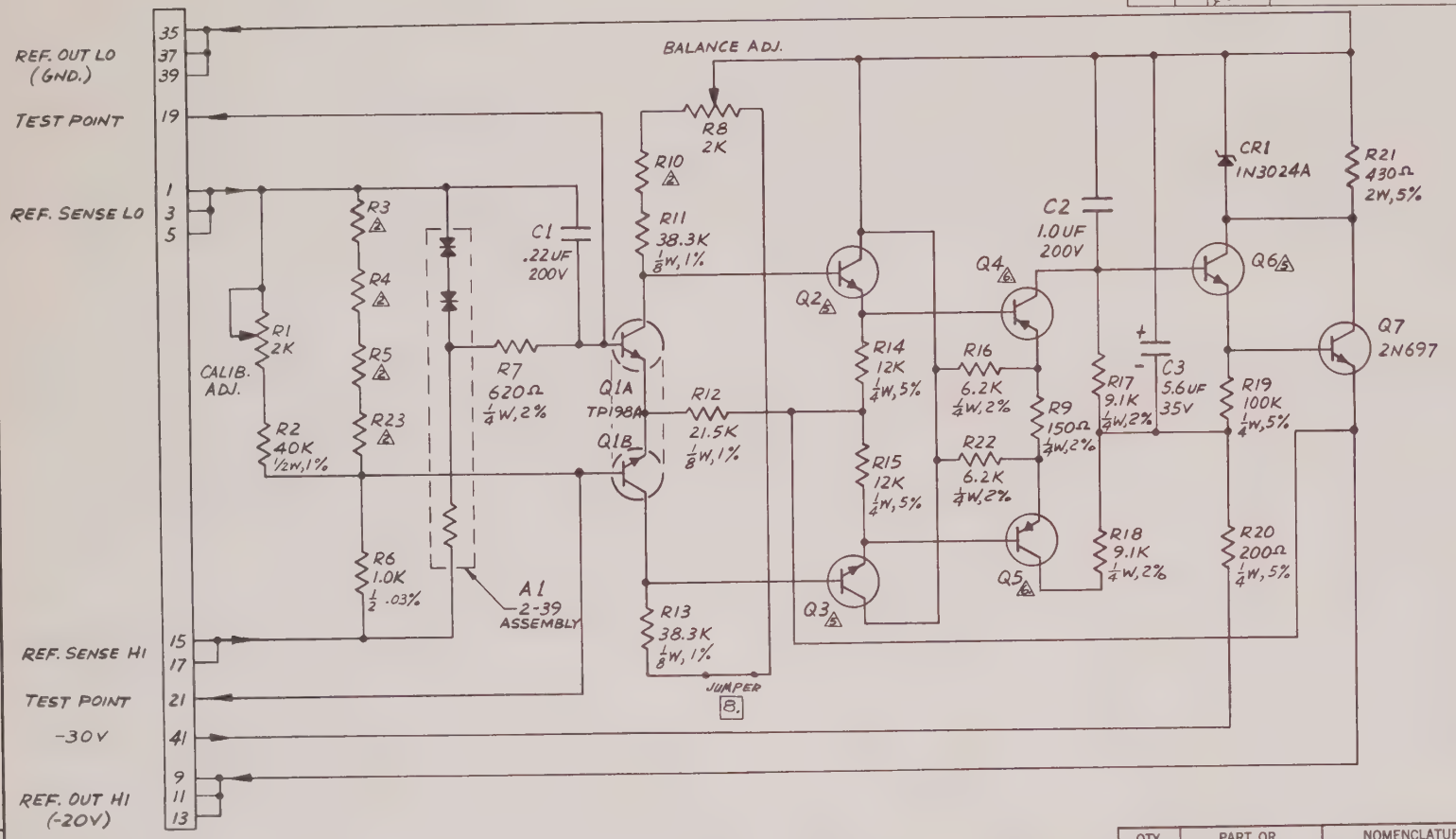
Scan Control Assembly - 36-494

S. S. - Single scan
H = AUTO RANGE - High signal = auto range
L = RANGE UP - Low signal = up range pulse
L = 1000V RANGE - Low signal = 1000V range relay enable
L = RANGE DOWN - Low signal = down range pulse
L = 10V RANGE - Low signal = 10V range relay enable
L = CHANGE POL. - Low signal = change polarity
H = AUTO POL. - High signal = auto polarity
INT. - Internal trigger
PC_3 SET ENABLE - Program counter state 3 = set enable
PC_2 - Program counter state 2


ENCODE
(D)(CL2)
GND
CL22
(D)(CL2)
GND
Z DECS
CL22
GND
CL21
(D)(CL1)
CL11
CL12
A1A9
A1A8
CL2,
CL1,
CL12
(D)(CL1)
GND
GND
GND
NOTES UNLESS OTHERWISE SPECIFIED!
1. ALL RESISTORS ARE ¼W 5%.
2. ALL PNP TRANSISTORS ARE 2N3906/2N3638A/2N3702.
3. ALL NPN TRANSISTORS ARE 2N3904/2N3565/2N3711
4. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A1A8 (A1A9.
2N1305
R1-73 +15V
2.2K
220 pf 500V
PIN
R2-24 -5V
TYPICAL CIRCUIT
REVISIONS
ZONE | LTR. | EFFECT. | DESCRIPTION | DATE | APPROVED
D | 5/N.15 & ON | REDRAWN; PINS 37 & 38 WERE GND, "ENCODE" WAS "START" | 6-7-66 MTS | Hoffheimer
A718 | E | 5/N.155 ONLY | ADDED NOTE 4. 8-10-66 DN. | 8-11-66 | J Knight
PARTS LIST
QTY REQD | PART OR IDENTIFYING NO. | NOMENCLATURE OR DESCRIPTION | MFR. CODE | CIRCUIT REF. | ITEM NO.
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ± .010 ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL
CONTR. NO.
DRAWN D.DL 12-21-65
CHECK T.LAM 3-31-66
APPR R HOFHEIMER 4-4-66
RELEASE DATE 4-8-66
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA
SCHEMATIC
DECADE COUNTER
SERIES X-1
SIZE D | CODE IDENT NO. 03626 | 36-8
SCALE NONE | WEIGHT | SHEET 2 OF 2
3G-205 | 3G-205 | 2 | 2
NEXT ASSY. | FINAL ASSY. | NEXT ASSY | FINAL ASSY
APPLICATION | QTY.
36-8 REV. E

REVISIONS					
SYM	ZONE	EFFECT.	DESCRIPTION	DATE	APPROVED
F		S/N. 115 & ON	ADDED NOTE 9	8-2-66	R.T. Nelson
G		S/N. 116 & ON	INC E.O. 1 of CHG "F" -HD	9-12-66	9-12-66 R.T. Nelson

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
	C	S/N. 1 & ON	REDRAWN WAS REV. 2.	5-3-66 WAS 9	Hufheimer
F/D	D	S/N. 15 & ON	CHG'D.: R7, R9, R16, R17, R18 & R22 FROM 1/8W, TO 1/4W. 6-16-66 DH.	4/20/66	Hufheimer
F/D	E	S/N. 15 & ON	INCORP. E.O. 1 of CHG. D, & ADDED NOTE 7 DH.	8-10-66	L. Smith
		S/N 255 & ON	ADDED NOTE 8 & JUMPER	9/11/66	R. Warner



QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

2. R2-6 & R23 ARE PW2016 C
8. ALTERNATE LOCATION FOR R10. REF. 36-11 SHT 1 NOTE 4
7. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A3A6.
6. 2N3906, 2N3638A, MPS6518, 2N3702.
5. 2N3904, 2N3711, 2N3565
4. DOCUMENT 719 GIVES INSTRUCTION FOR ADJUSTING R1.
3. DOCUMENT 715 GIVES INSTRUCTION FOR ADJUSTING R8.
2. RESISTORS R3, 4, 5, 10 & 23 ARE SELECTED, SEE DOC. 715.
1. RESISTORS ARE 1/8 W, 2%.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
36-208	36-205	1	1
36-203	36-204	1	1
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

MATERIAL

CONTR. NO.		
DRAWN	H. BRINLEY	5-2-66
CHECK	[illegible]	5-4-66
APPR	Hufheimer	5-9-66
RELEASE DATE	5-4-66 (2)	

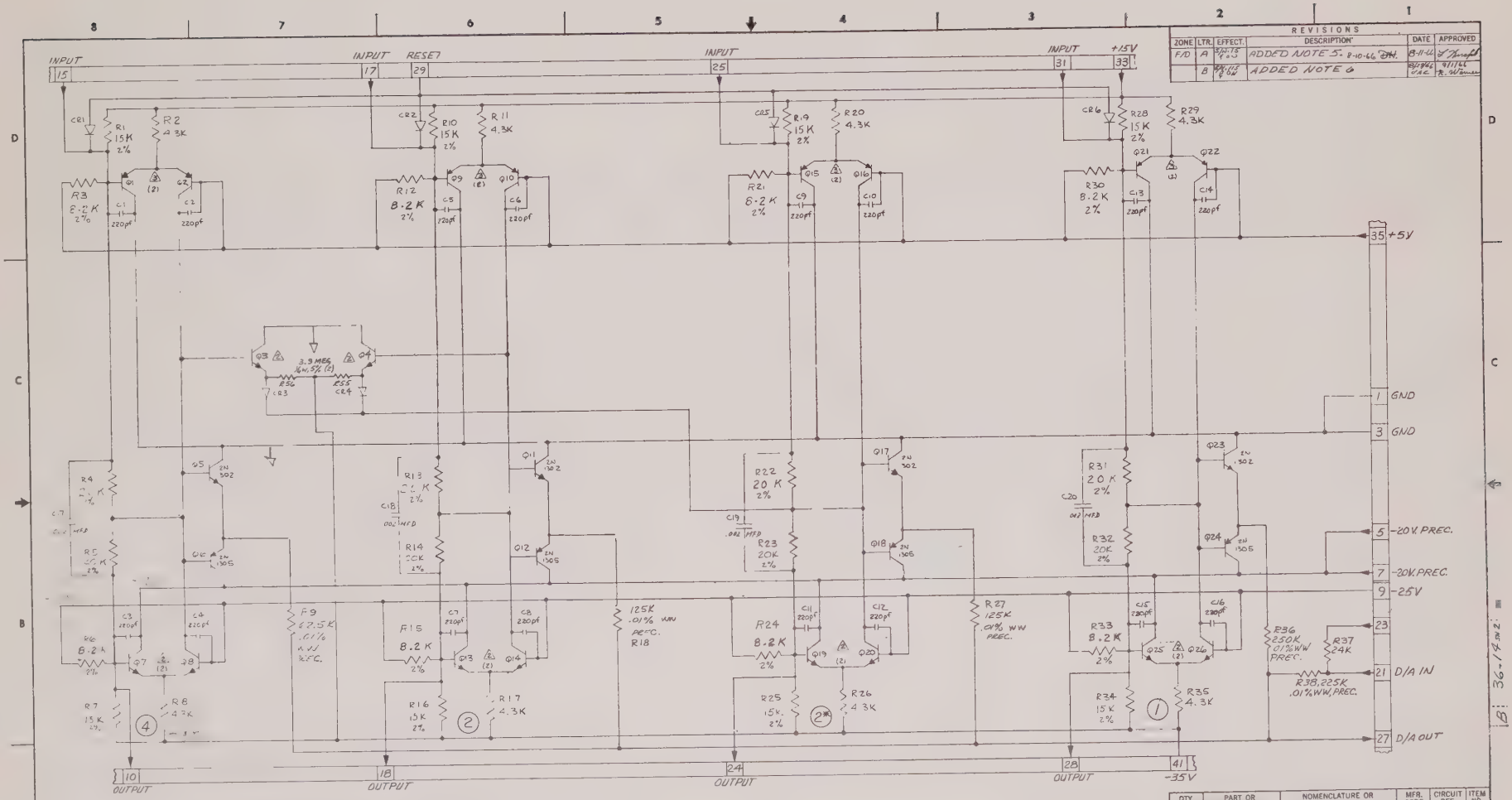
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC, REFERENCE SUPPLY

SERIES X-1

SIZE	CODE IDENT NO.	
C	03626	36-11
SCALE	WEIGHT	SHEET 2 OF 2

6/66 DIETERICH-POST CLEARPRINT 1000H-10



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
F/D	A	5/31/66 F&S	ADDED NOTE 5. P-10-66 DW.	8-11-66	J. Wright
	B	8/15/66 F	ADDED NOTE 6	8/24/66 D.A.C.	9/11/66 R. Williams

A INSULATION RESISTANCE BETWEEN PIN 35 & PIN 41 SHOULD BE 200,000 MEGOHMS MINIMUM WITH THE MEGOHMMETER SET AT 50 V

2 2N3906 / 2N3638A / 2N3702

2 2N3904 / 2N3565 / 2N3711

1. ALL RESISTORS ARE ¼W 5% UNLESS OTHERWISE NOTED.

6. R9, R27, R38 ARE PW2016C.

5. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A1A10 THRU A1A13.

NOTES: UNLESS OTHERWISE SPECIFIED

36-205 NEXT ASSY.	36-205 FINAL ASSY.	4 NEXT ASSY.	4 FINAL ASSY.
APPLICATION		QTY.	

EFFECT SN 115 & ON

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010 ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.		
DRAWN	HOFHEIMER	7-3-65
CHECK	T. Ham	7-11-66
APPR	Preference	7/11/66
RELEASE DATE	7-11-66	

MATERIAL

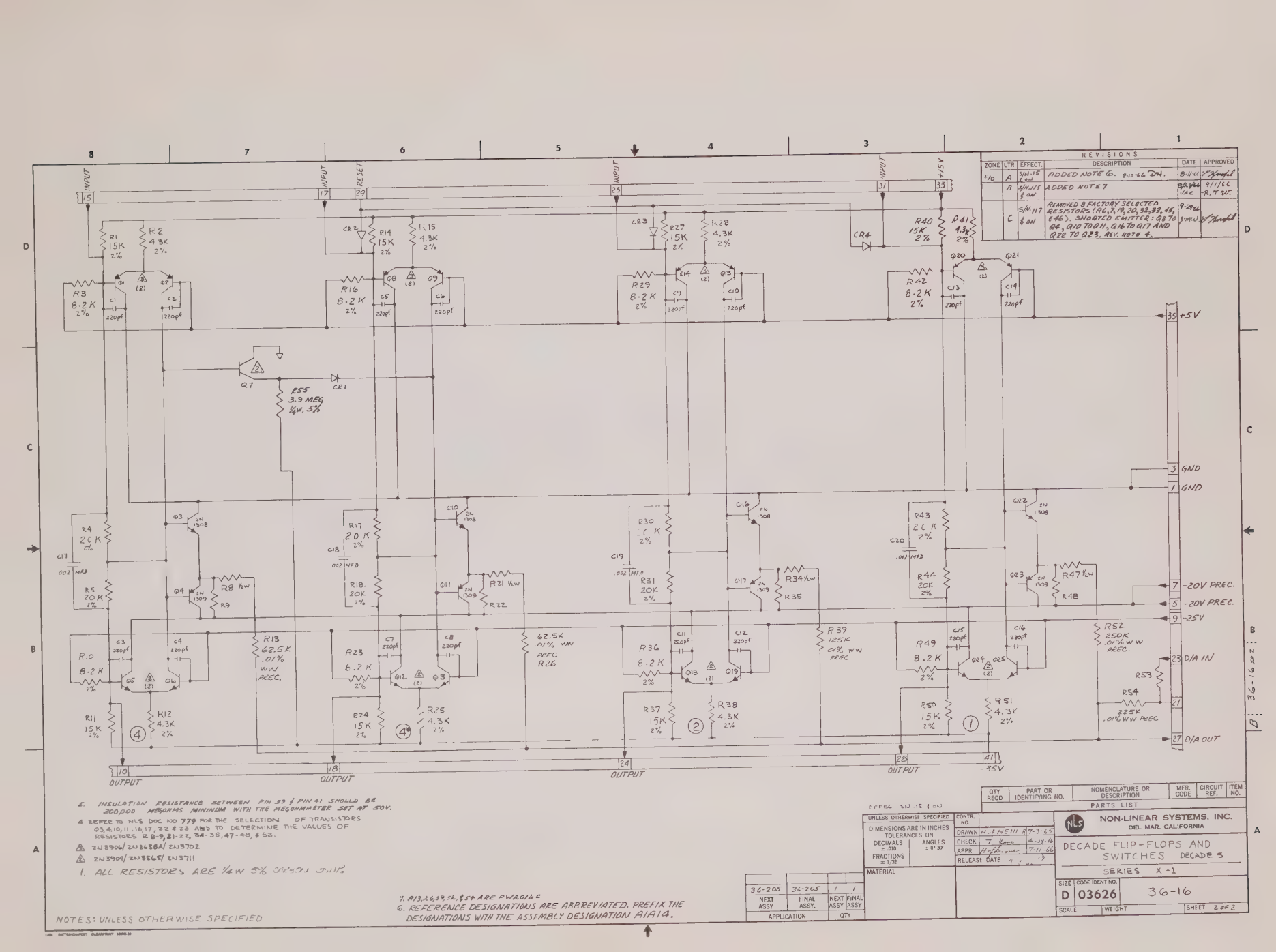
NON-LINEAR SYSTEMS, INC
DEL MAR, CALIFORNIA

DECADE FLIP-FLOPS AND SWITCHES

DECADES 1-4 SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-14
SCALE	WEIGHT	SHEET 2 of 2

36-14 rev B



REVISIONS					
ZONE	LTR	EFFECT.	DESCRIPTION	DATE	APPROVED
F/D	A	S/N 115 & on	ADDED NOTE 6. 8-10-66 DH.	8-11-66	
	B	S/N 115 & ON	ADDED NOTE 7	9/1/66 JAE	
	C	S/N 117 & ON	REMOVED 8 FACTORY SELECTED RESISTORS (R6, 8, 19, 20, 32, 33, 45, & 46), SHORTED EMITTER: Q2 TO Q4, Q10 TO Q11, Q16 TO Q17 AND Q22 TO Q23. REV. NOTE 4.	9-29-66	

1. ALL RESISTORS ARE ¼W 5% 0/2+0.1 3.111%
2. REFER TO NLS DOC NO 779 FOR THE SELECTION OF TRANSISTORS Q3,4,10,11,16,17,22 & 23 AND TO DETERMINE THE VALUES OF RESISTORS R 8-9, 21-22, 34-35, 47-48, & 53.
3. ZN3906/ZN3638A/ZN3702
4. ZN3909/ZN3565/ZN3711
5. INSULATION RESISTANCE BETWEEN PIN 33 & PIN 41 SHOULD BE 200,000 MEGOHMS MINIMUM WITH THE MEGOHMMETER SET AT 50V.
6. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A1A14.
7. R13,26,39,52, & 54 ARE PWR01&C

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

36-205	36-205	1	1
NEXT ASSY	FINAL ASSY.	NEXT ASSY	FINAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010 ANGLES ± 0°30'
FRACTIONS ± 1/32

CONTR. NO
DRAWN N.E.HEIN 7-3-65
CHECK T. Kwan 8-31-66
APPR Walter Jones 7-11-66
RLLEASE DATE 7-11-66

MATERIAL

NLS NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

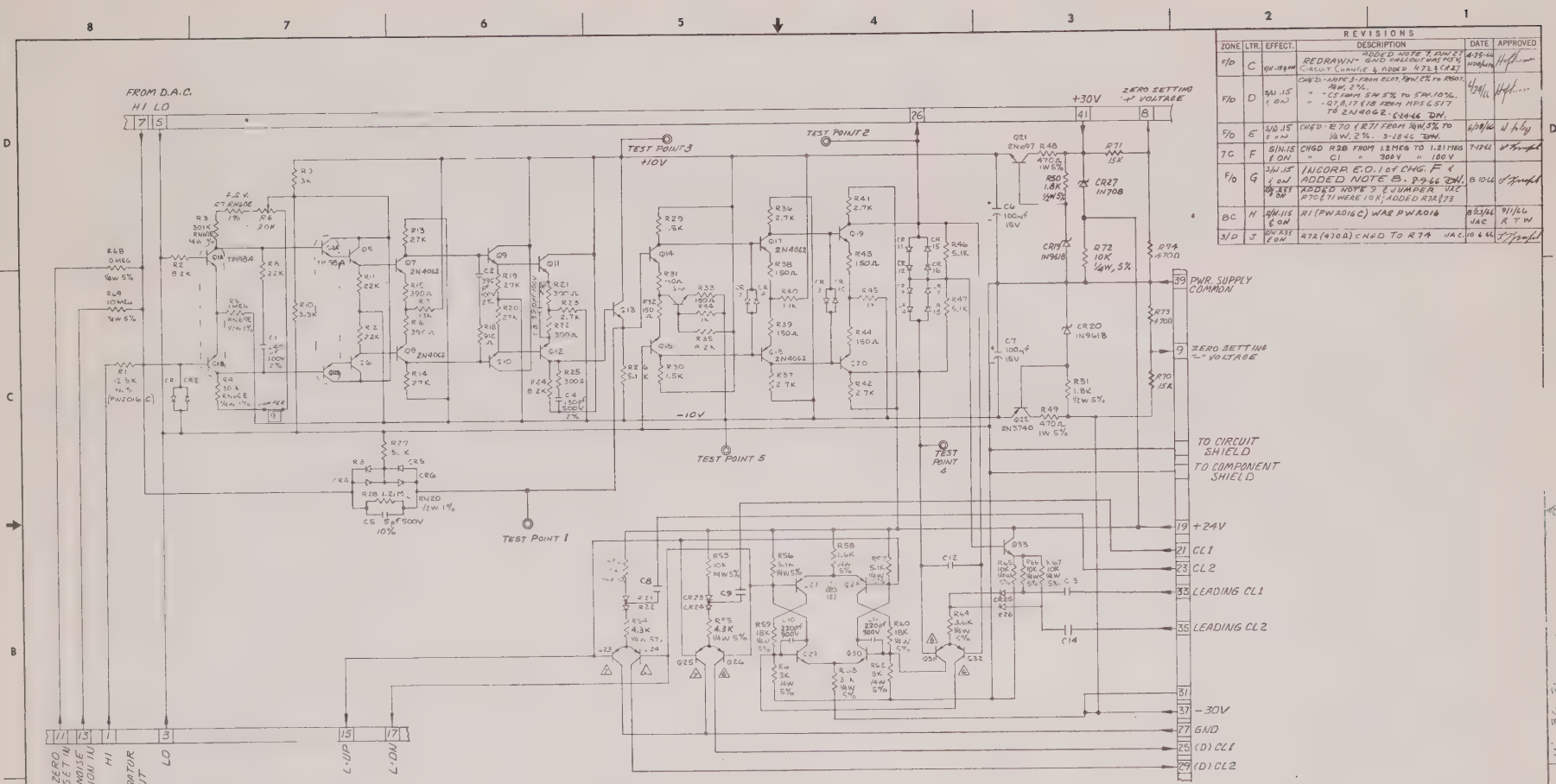
DECADE FLIP-FLOPS AND SWITCHES DECADE 5

SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-16

SCALE WEIGHT SHEET 2 OF 2

36-16 REV B



NOTES, EXCEPT AS NOTED!
1. ALL CAPACITORS .002 μf 500V
2. ALL DIODES 1N5003-002.
3. ALL RESISTORS ARE RC07, ¼W, 2%.
4. ALL TRANSISTORS 2N3904, 2N3565, 2N3711 (NPN)
5. INSTRUCTIONS FOR SELECTING R7 & ADJUSTING R6 ARE GIVEN IN DOC. NO. 713.

△ 2N3906, 2N3638A, 2N3702. (PNP)

△ 2N3648, 2N3906.

8 REFERENCE DESIGNATIONS ARE ABBREVIATED PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY

[9] ALTERNATE LOCATION FOR R7, REF 36-26 SHT1, NOTE △

REVISIONS

ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
F/D	C	6/N.15 & ON	REDRAWN - ADDED NOTE 7, R2W,27 GND CALLOUT MAP 05 % CIRCUIT CHANGE & ADDED R72 & CR27	4-25-66 MOD Kam	Hff
F/D	D	5/N .15 & ON	CHG'D - NOTE 3 - FROM ELOT, ¼W, 2% TO ¼W, 5%. " " CF FROM 5W 5% TO 5W, 10%. " " - Q7,8,17 (18 FROM MPS L51 TO 2N4062 - 6-24-66 DM.	6/24/66	Hff
F/D	E	5/D .15 & ON	CHG'D - R70 & R71 FROM ¼W, 5% TO ¼W, 2%. 3-28-66 DM.	6/29/66	M Hoy
7C	F	5/N.15 & ON	CHGD R2B FROM 1.2 MEG TO 1.21 MEG " C1 " 300V " 100V	7-12-66	
F/D	G	5/N .15 & ON 5/D .15 & ON	INCORP E.O. 107 CHG. F & ADDED NOTE 8. 8-9-66 DM. ADDED NOTE 9 & JUMPER JAC R70, 71 WERE 10K; ADDED R2A, 73	8-10-66	
8C	H	6/N.115 & ON	R1 (PW2016C) WAS PW2016	8-23-66 JAC	9/1/66 R T W
3/D	J	10/N .33 & ON	R72 (470Ω) CHGD TO R74	JAC 10-6-66	

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

36 205	36-203	1	1
NEXT ASSY.	FINAL ASSY.	NEXT ASSY	FINAL ASSY.
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR NO.

DRAWN	DIAL	1-3-66
CHECK	[illegible]	
APPR	I HOOD	4-6-66
RELEASE DATE	4-8-66	

MATERIAL

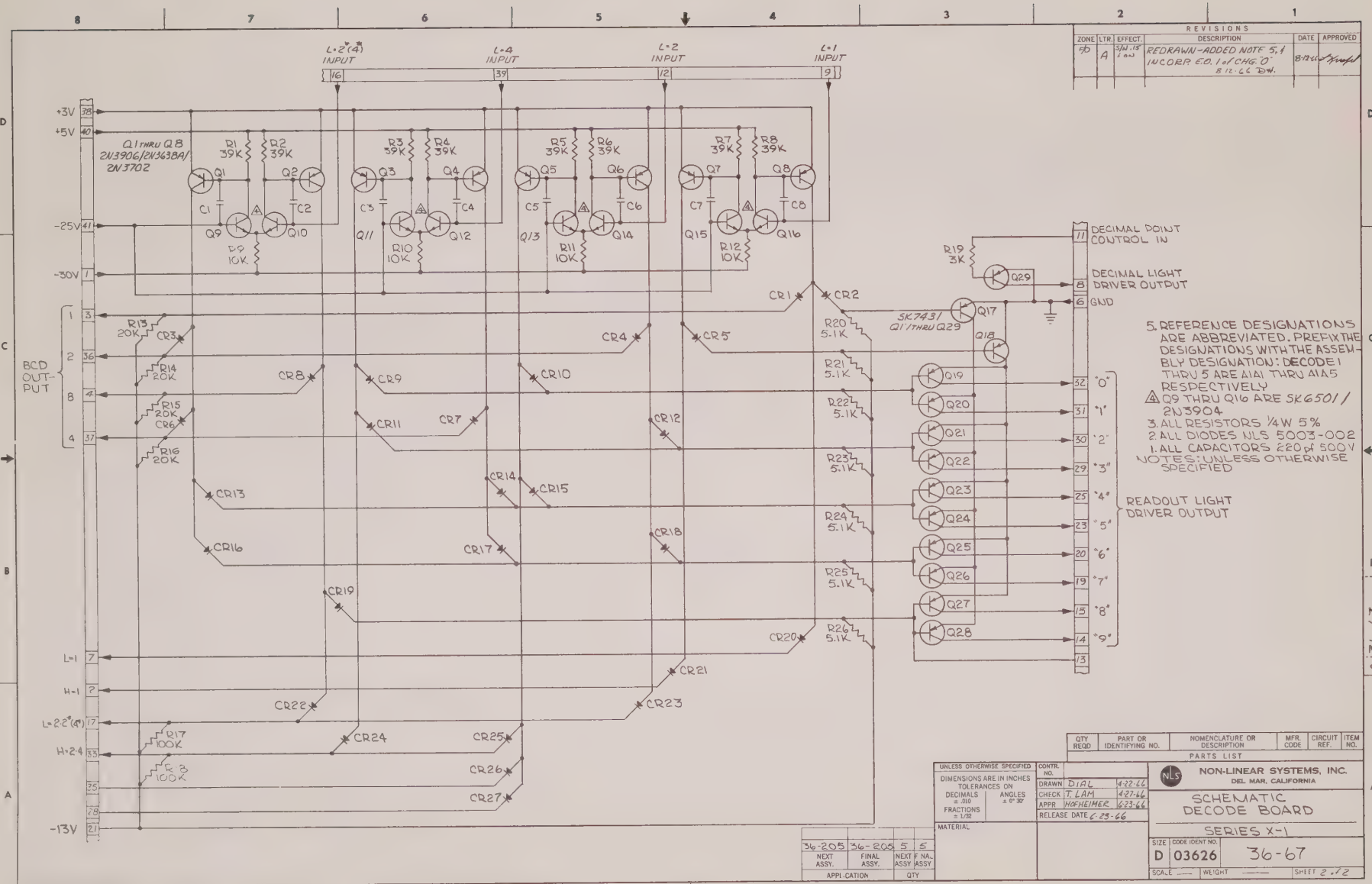
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC - COMPARATOR

SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-26

SCALE NONE WEIGHT SHEET 2 OF 2



5. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION: DECODE 1 THRU 5 ARE A1A1 THRU A1A5 RESPECTIVELY
4. Q9 THRU Q16 ARE SK6501 / 2N3904
3. ALL RESISTORS ¼W 5%
2. ALL DIODES NLS 5003-002
1. ALL CAPACITORS 220 pf 500V

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
5D	A	S/N 18 & ON	REDRAWN-ADDED NOTE 5, 4 INCORP. E.O. 1 of CHG. 0 8-12-66 DW.	8-12-66	

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

NEXT ASSY.	FINAL ASSY.	NEXT ASSY	FINAL ASSY
36-205	36-205	5	5

APPLICATION — QTY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

CONTR. NO.		
DRAWN	DIAL	4-22-66
CHECK	T. LAM	4-27-66
APPR	HOFHEIMER	6-23-66
RELEASE DATE	6-29-66	

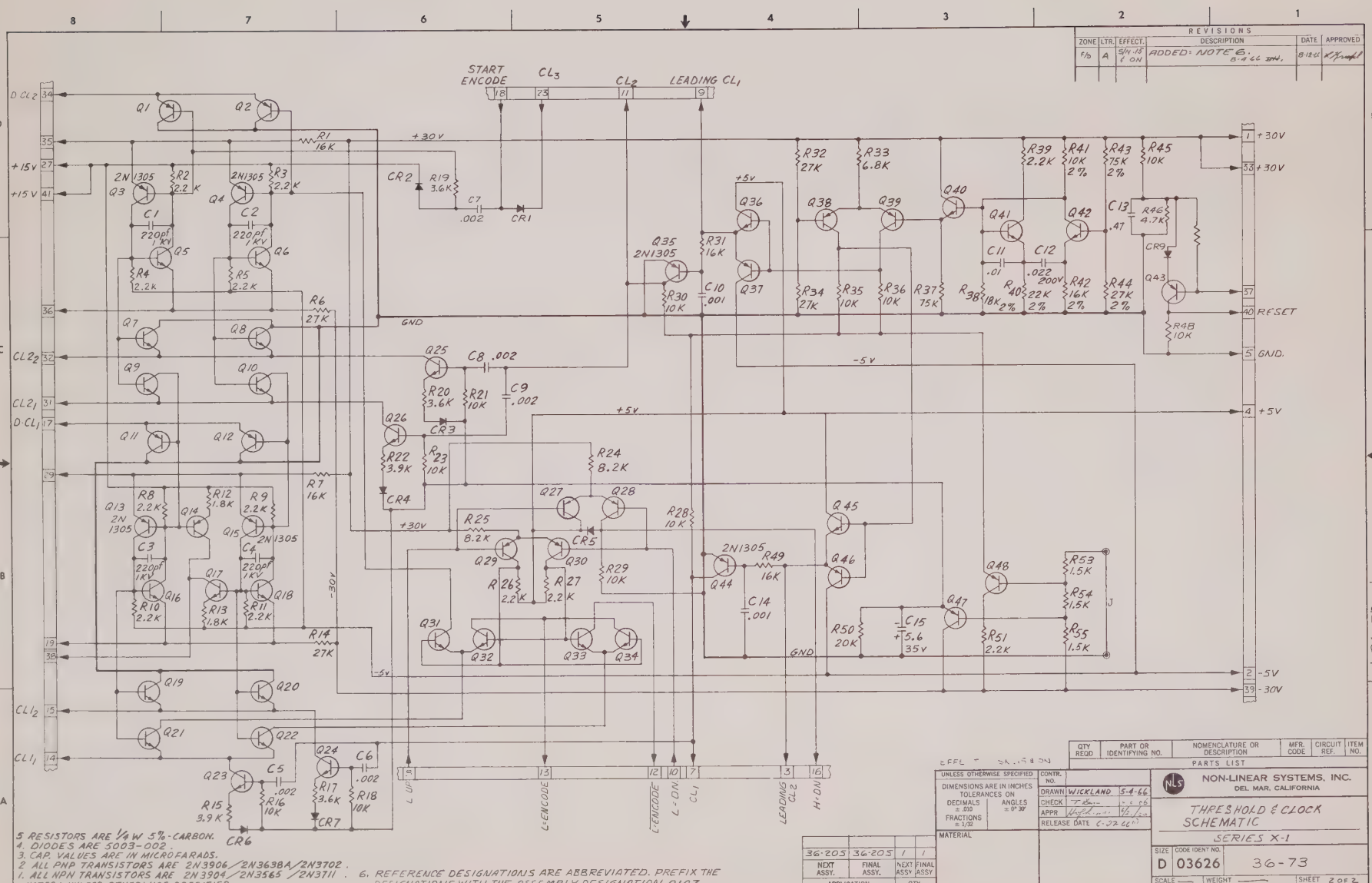
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC
DECODE BOARD
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-67

SCALE —— WEIGHT —— SHEET 2 of 2

A 36-67 SH 2



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
F/D	A	S/N 15 & ON	ADDED: NOTE 6. 5-4-66 DH.	8-12-66	KF

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.
PARTS LIST					

EFFL. F S/N 15 & ON

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

CONTR. NO.
DRAWN WICKLAND 5-4-66
CHECK
APPR
RELEASE DATE 6-27-66

MATERIAL

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

THRESHOLD & CLOCK SCHEMATIC
SERIES X-1

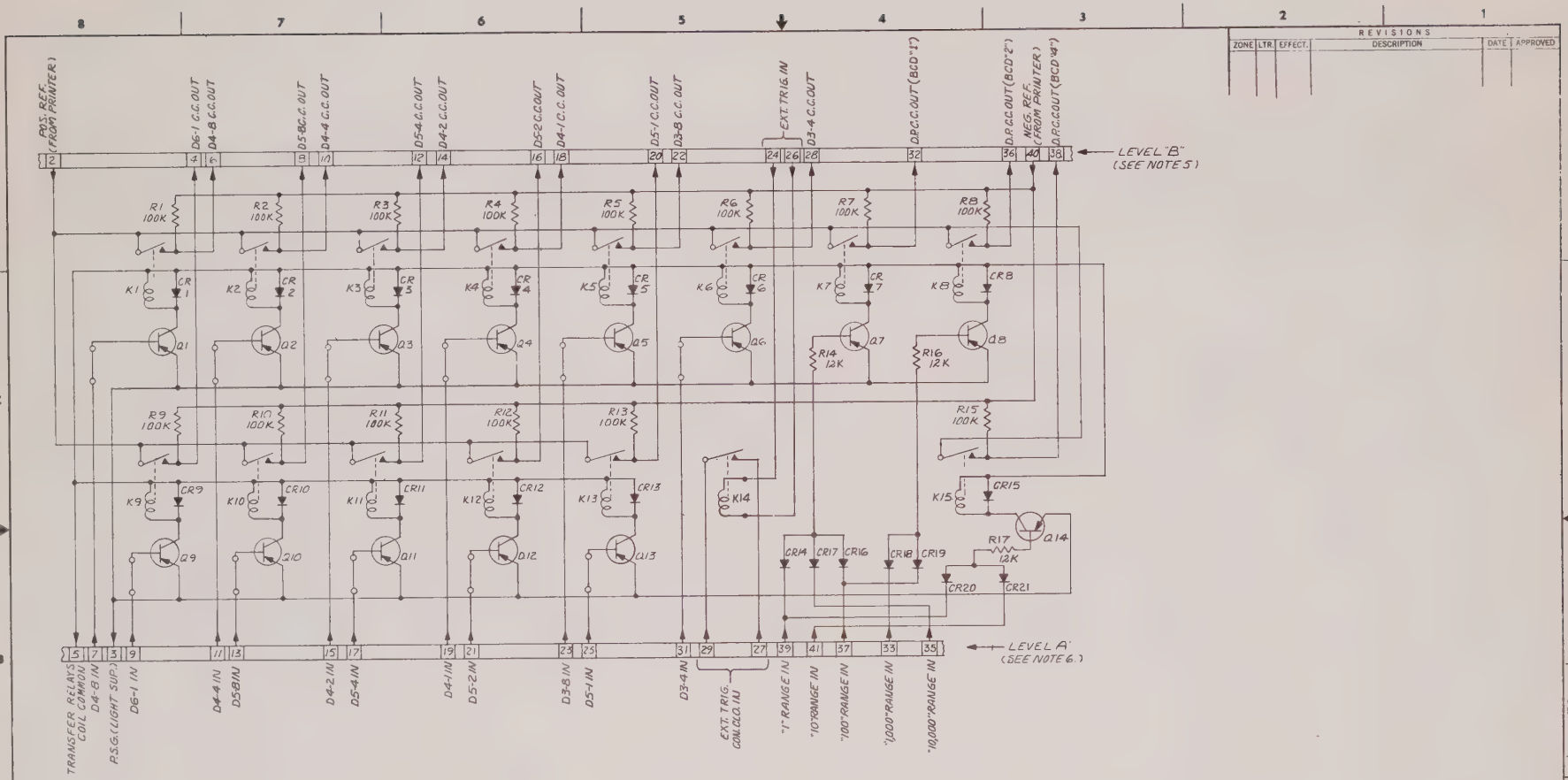
SIZE D | CODE IDENT NO. 03626 | 36-73
SCALE — | WEIGHT — | SHEET 2 OF 2

36-205 NEXT ASSY.	36-205 FINAL ASSY.	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY.	

5 RESISTORS ARE 1/4 W 5%-CARBON.
4. DIODES ARE 5003-002.
3. CAP. VALUES ARE IN MICROFARADS.
2 ALL PNP TRANSISTORS ARE 2N3906/2N3638A/2N3702.
1. ALL NPN TRANSISTORS ARE 2N3904/2N3565/2N3711.
NOTES: UNLESS OTHERWISE SPECIFIED

6. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A1A7.

A1 36-73 SH 2



7. REFERENCE DESIGNATIONS ARE ABBREVIATED; PREFIX WITH ASSY. DES16. SHOWN ON SH. 2 OF FINAL ASSY.
6. LEVEL "A" MEANS PINS CONNECTED TO "INSIDE WORLD" CIRCUITRY BY P.C. - ODD NUMBERED PINS NEAREST REAR OF METER.
5. LEVEL "B" MEANS PINS CONNECTED TO "OUTSIDE WORLD" CIRCUITRY USING HARDWIRE ON COMPONENT SIDE OF BOARD, EVEN NUMBERED PINS NEAREST FRONT OF METER.
4. ALL TRANSISTORS ARE 2N3644/SK7431.
3. ALL RELAYS ARE NLS TYPE S-12-27.
2. ALL DIODES ARE NLS TYPE 5003-002.
1. ALL RESISTORS ARE 1/4W, 5%.

NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO
DRAWN Hernandez 8-26-66
CHECK I. HOOD 8.30.66
APPR E. Hoffman 9/29/66
RELEASE DATE 6-25-68 (A)

MATERIAL

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

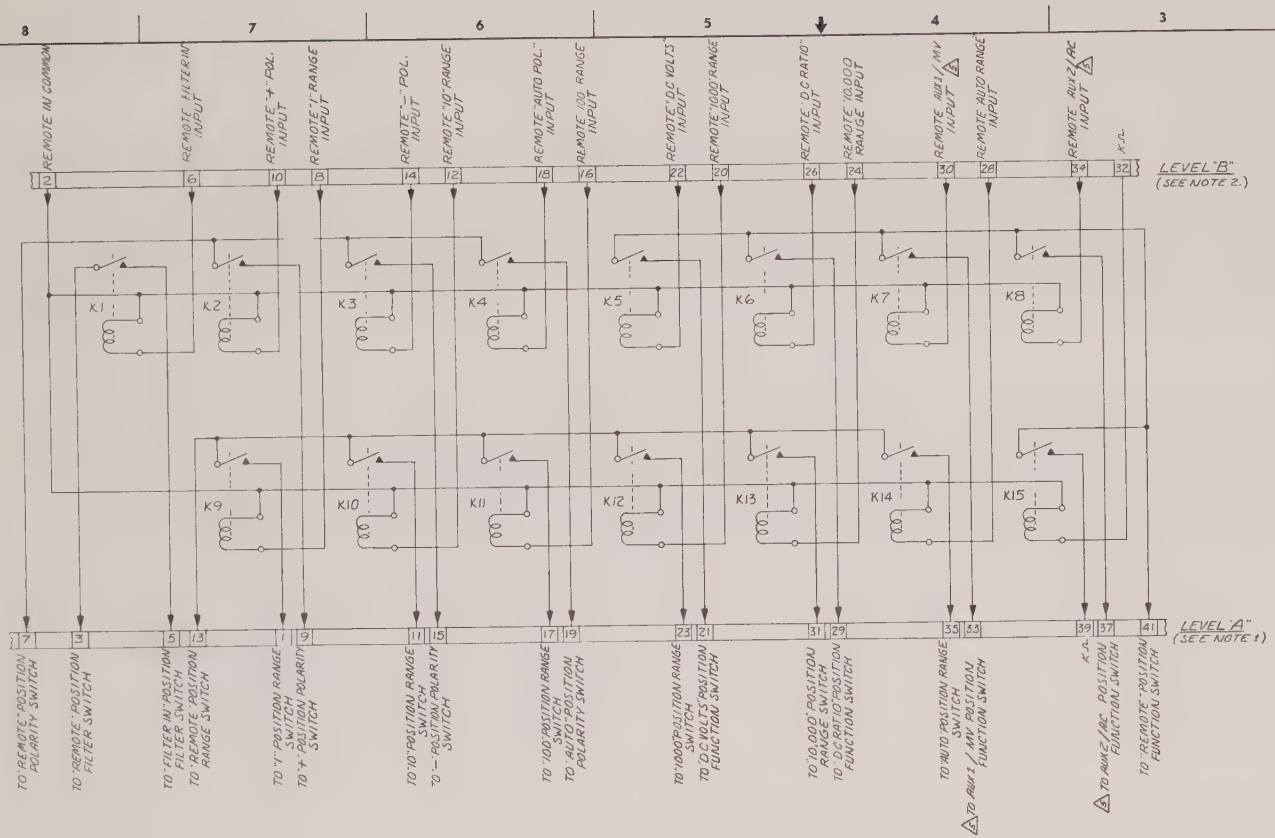
SCHEMATIC-
TRANSFER B/D NO 1
SERIES X-1

SIZE	CODE IDENT NO.	36-179
D	03626	

SCALE | WEIGHT | SHEET 2 of 2

36-218 NEXT ASSY.	36-218 FINAL ASSY	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY.	

36-179 SH. 2



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
	A		ADDED, "I.D. AT PIN 32 & 39", "/ AC AT PIN 34 & 37", & " / MV AT PIN 30 & 33". ADDED NOTE 5. TO	10-21-66	

⚠ "AUX 1" & "AUX 2" APPLY TO 36-218 ONLY.

4. REF. DESIG. ARE ABBREV.; PREFIX WITH ASSY DESIG SHOWN ON SH 2 OF FINAL ASSY.

3. ALL RELAYS ARE [illegible] TYPE S-12-27.

2. LEVEL B MEANS PINS CONNECTED TO "OUTSIDE WORLD" CIRCUITRY USING HARDWIRE ON COMPONENT SIDE OF BOARD, EVEN NUMBERED PINS NEAREST FRONT OF METER.

1. LEVEL "A" MEANS PINS CONNECTED TO "INSIDE WORLD" CIRCUITRY BY P.C.-ODD NUMBERED PINS NEAREST REAR OF METER.

NOTES: UNLESS OTHERWISE SPECIFIED.

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

NEXT ASSY	FINAL ASSY.	NEXT ASSY	FINAL ASSY.
36-218	36-218	1	1
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

CONTR. NO.
DRAWN Hanrahan 8/29/66
CHECK [illegible] 9/25/66
APPR R. Hoffman 8/21/66
RELEASE DATE 8-25-66

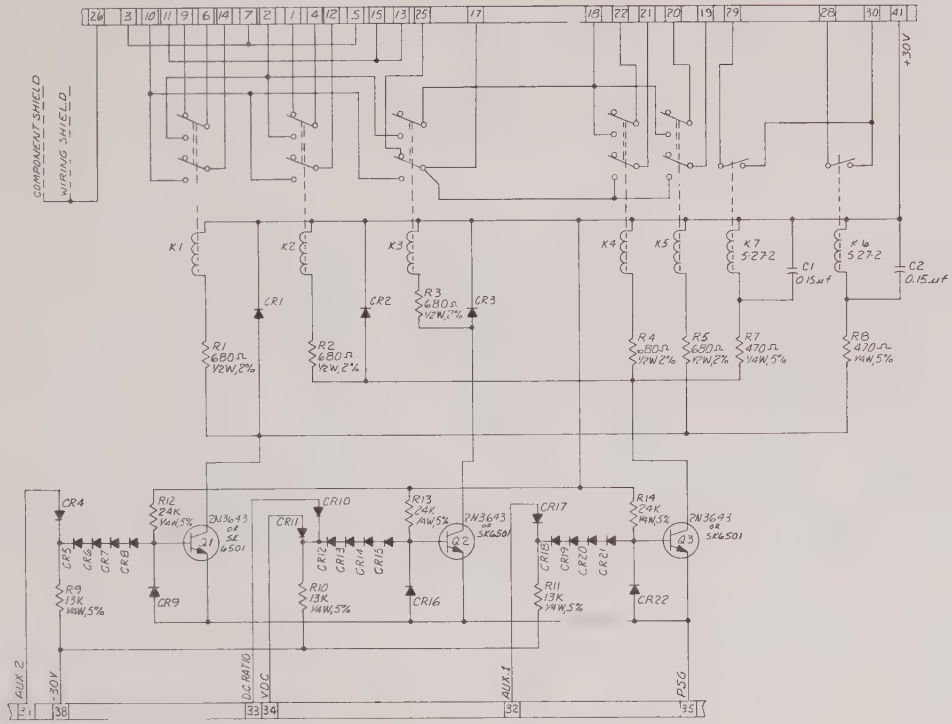
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC - (REMOTE INPUT) TRANSFER BOARD #3
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-185

SCALE — WEIGHT — SHEET 2 of 2

36-185 SH 2 of 2



3. REF DESIG. ARE ABBREV.; PREFIX WITH ASSY. DESIG. SHOWN ON SH 2 OF FINAL ASSY.

2. K1 THRU K5 ARE NLS TYPE 5005-007 RELAYS

1 ALL DIODES ARE NLS TYPE 5003-002.

NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

NEXT ASSY.	FINAL ASSY.	NEXT ASSY	FINAL ASSY
36-218	36-218	1	1
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

MATERIAL

CONTR. NO.

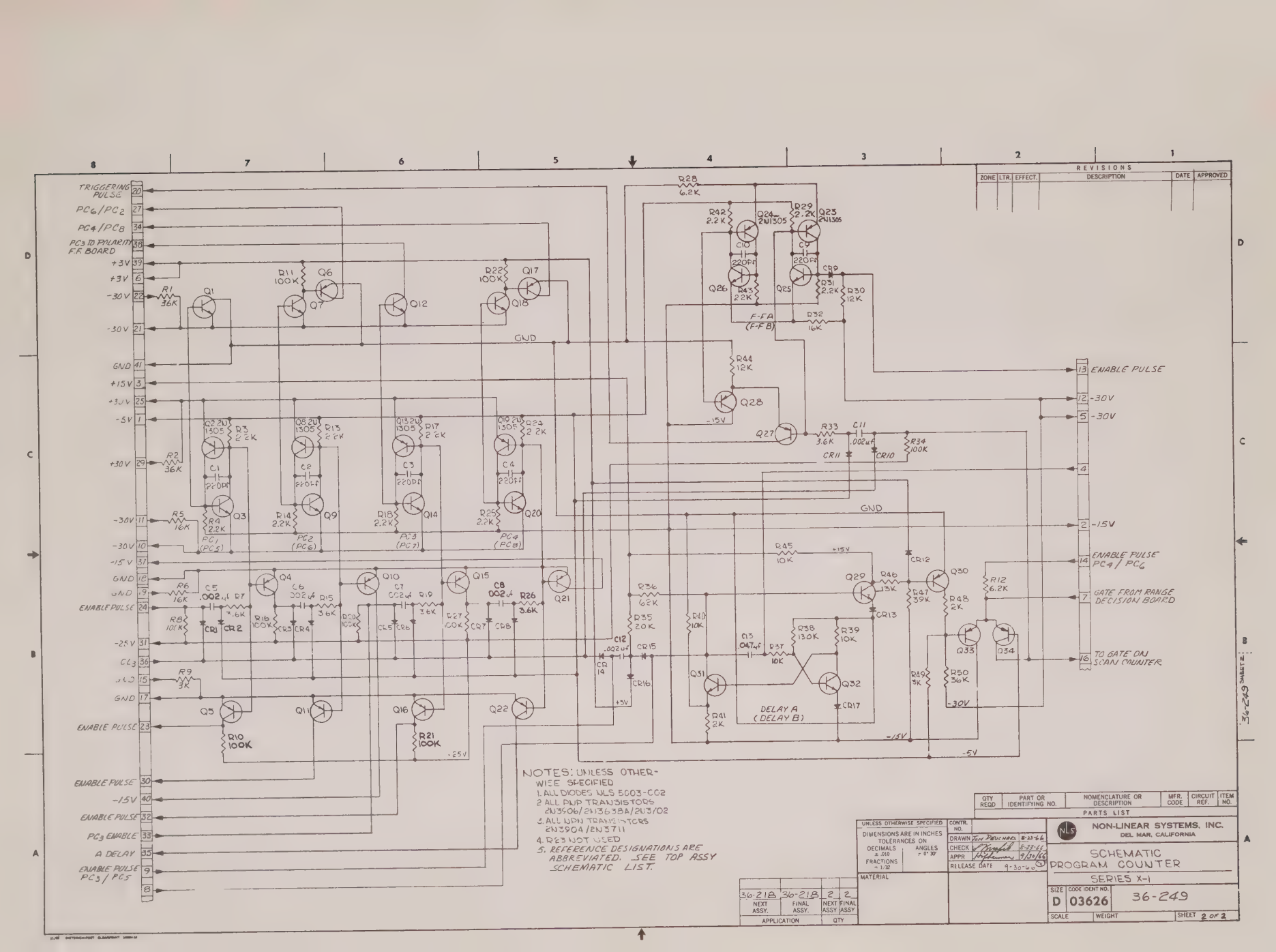
DRAWN	Pamela D.	8-1-66
CHECK	D. FOLEY	8-8-66
APPR	P. Hyman	9/9/66
RELEASE DATE	9-29-66	

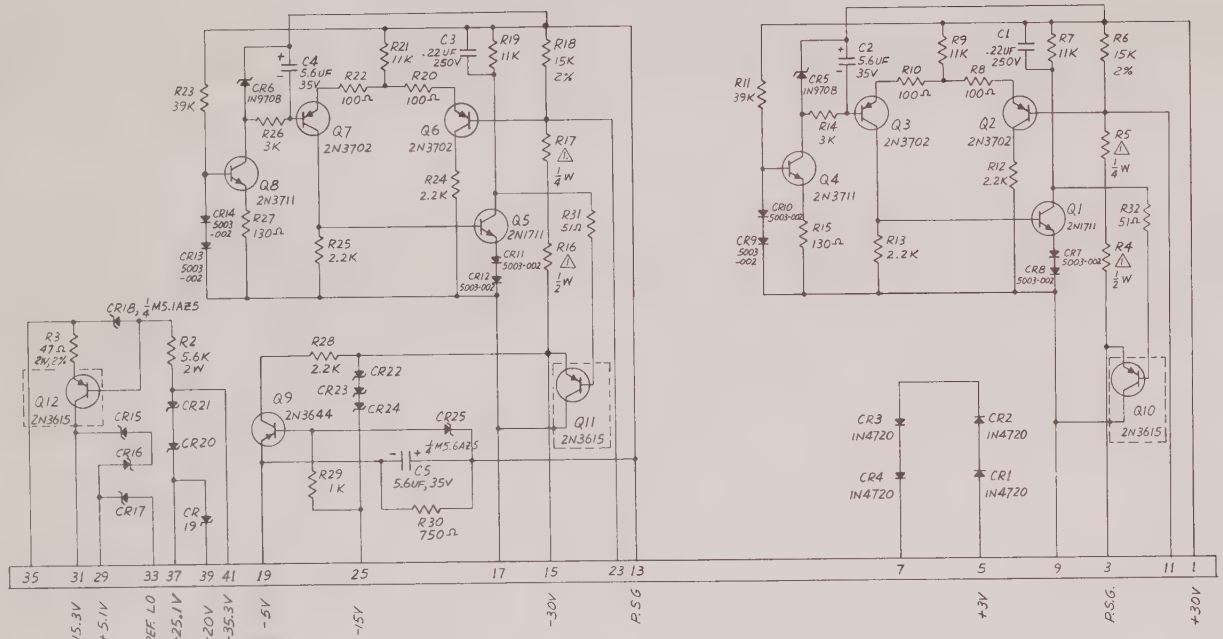
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC —
FUNCTION SWITCHING LOGIC
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-191
SCALE	WEIGHT	SHEET 2 of 2

36-191


TRIGGERING PULSE
PC6/PC2
PC4/PC8
PC3 TO POLARITY F.F. BOARD
+3V
+3V
-30V
-30V
GND
+15V
+30V
-5V
+30V
-30V
-30V
-15V
GND
GND
ENABLE PULSE
-25V
GND
ENABLE PULSE
ENABLE PULSE
-15V
ENABLE PULSE
PC3 ENABLE
A DELAY
ENABLE PULSE PC3 / PC5
ENABLE PULSE
-15V
-30V
-30V
GATE FROM RANGE DECISION BOARD
TO GATE ON SCAN COUNTER
DELAY A (DELAY B)
F-F A (F-F B)
PC1 (PC5)
PC2 (PC6)
PC3 (PC7)
PC4 (PC8)
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIODES WLS 5003-CC2
2. ALL PNP TRANSISTORS 2N3906/2N3638A/2N3702
3. ALL NPN TRANSISTORS 2N3904/2N3711
4. R23 NOT USED
5. REFERENCE DESIGNATIONS ARE ABBREVIATED. SEE TOP ASSY SCHEMATIC LIST.
REVISIONS
ZONE | LTR. | EFFECT. | DESCRIPTION | DATE | APPROVED
PARTS LIST
QTY REQD | PART OR IDENTIFYING NO. | NOMENCLATURE OR DESCRIPTION | MFR. CODE | CIRCUIT REF. | ITEM NO.
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ± .010 FRACTIONS ± 1/32 ANGLES ± 0° 30'
CONTR. NO.
DRAWN Tom Prochaska 8-22-66
CHECK 8-22-66
APPR 9/30/66
RELEASE DATE 9-30-66
MATERIAL
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA
SCHEMATIC
PROGRAM COUNTER
SERIES X-1
SIZE D
CODE IDENT NO. 03626
36-249
SCALE
WEIGHT
SHEET 2 of 2
36-218 NEXT ASSY. | 36-218 FINAL ASSY. | 2 NEXT ASSY | 2 FINAL ASSY
APPLICATION | QTY



4. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION SHOWN ON SH.2 OF THE FINAL ASSEMBLY
3. DIODES CR15 THRU CR24 ARE IN3826A(EXCEPT CR18)
2. ALL RESISTORS ARE ¼ W, 5%
⚠ FACTORY SELECTED VALUES, REF. 36-266 SHT. 1.
NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.
DRAWN H. BRINLEY 8-18-66
CHECK 3-17-66
APPR 9/21/66
RELEASE DATE 9-21-66

MATERIAL

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

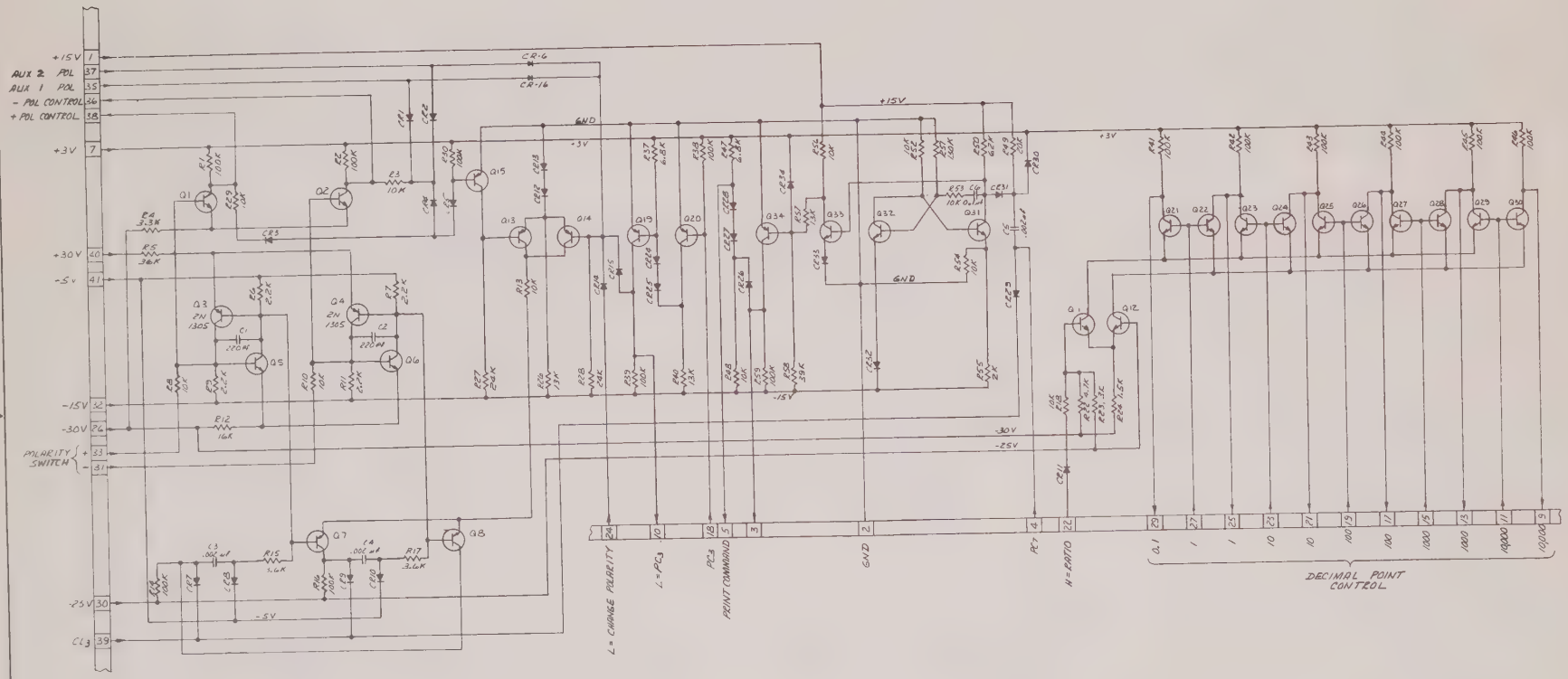
SCHEMATIC REGULATOR

SERIES X1

SIZE	CODE IDENT NO.	
D	03626	36-266
SCALE	WEIGHT	SHEET 2 OF 2

36-218 NEXT ASSY.	36-218 FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
APPLICATION		QTY	

36-266 SH. 2



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

4. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY
3. ALL DIODES NLS 5003-002
2. ALL NPN TRANSISTORS ARE 2N3904/2N3711
1. ALL PNP TRANSISTORS ARE 2N3906/2N3638A/2N3702.

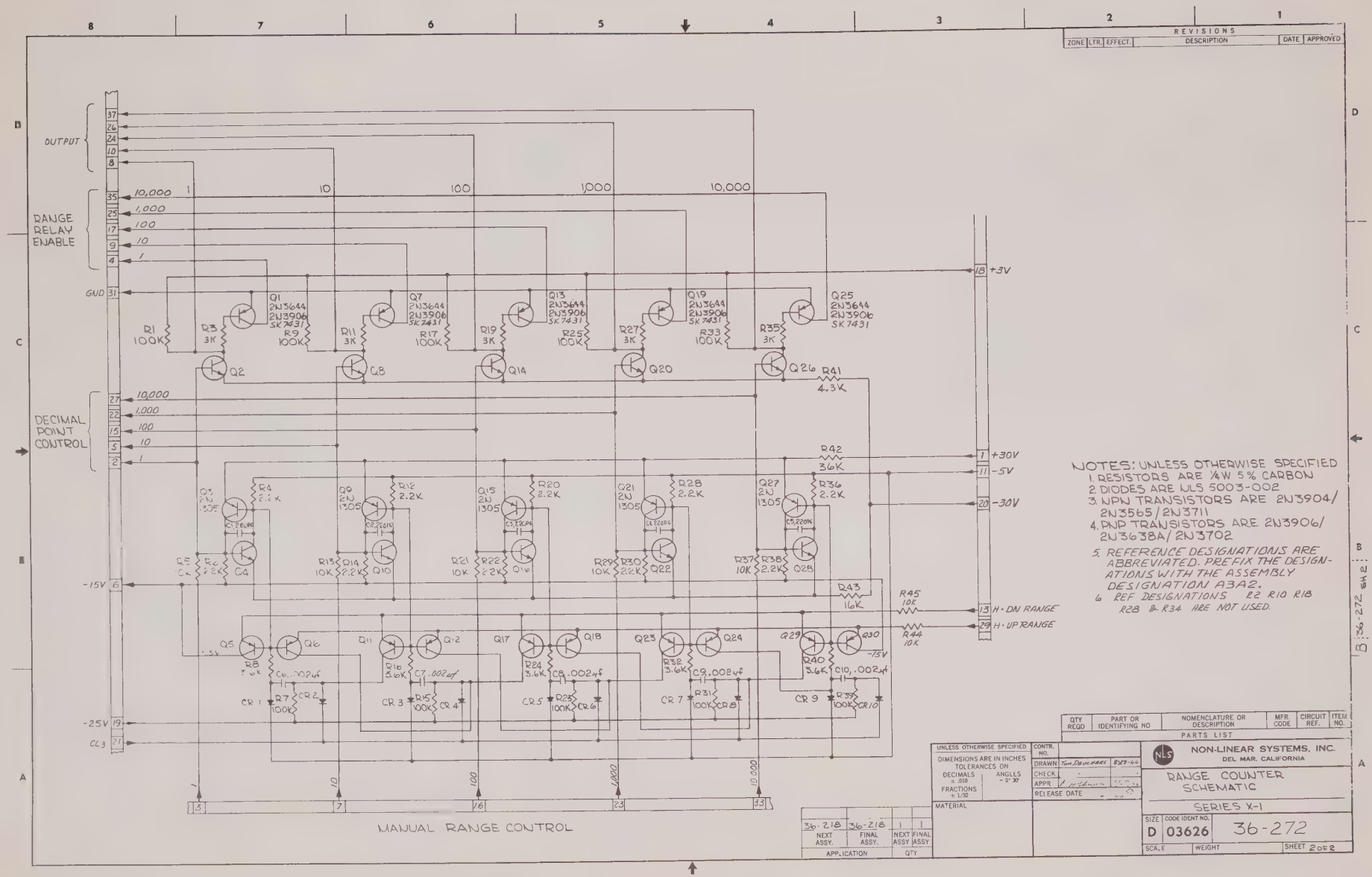
NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.
		PARTS LIST			

UNLESS OTHERWISE SPECIFIED	CONTR NO	NON-LINEAR SYSTEMS, INC. DEL MAR, CALIFORNIA
DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ± .010 ANGLES ± 0° 30' FRACTIONS ± 1/32	DRAWN Tom Dolkas 8/10/66	POLARITY FLIP-FLOP & LOGIC SCHEMATIC
	CHECK T. Lan 9/14/66	SERIES X-1
	APPR. [illegible] 9/19/66	SIZE D · CODE IDENT NO 03626 · 36-269
MATERIAL	RELEASE DATE 11-4-66	SCALE · WEIGHT · SHEET 2 OF 2

36-218 NEXT ASSY.	36-218 FINAL ASSY.	1 NEXT ASSY.	1 FINAL ASSY.
APPLICATION		QTY.	

DIETZGEN-POST CLEARPRINT 1555H-18



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE ¼W 5% CARBON
2. DIODES ARE IJLS 5003-002
3. NPN TRANSISTORS ARE 2N3904/ 2N3565/2N3711
4. PNP TRANSISTORS ARE 2N3906/ 2N3638A/2N3702
5. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE ASSEMBLY DESIGNATION A3A2.
6. REF DESIGNATIONS R22 R10 R18 R28 & R34 ARE NOT USED.

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

36-218 NEXT ASSY.	36-218 FINAL ASSY.	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.
DRAWN Tom Deschanes 8-23-66
CHECK -
APPR J. Hillman 11-1-66
RELEASE DATE

MATERIAL

NLS NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

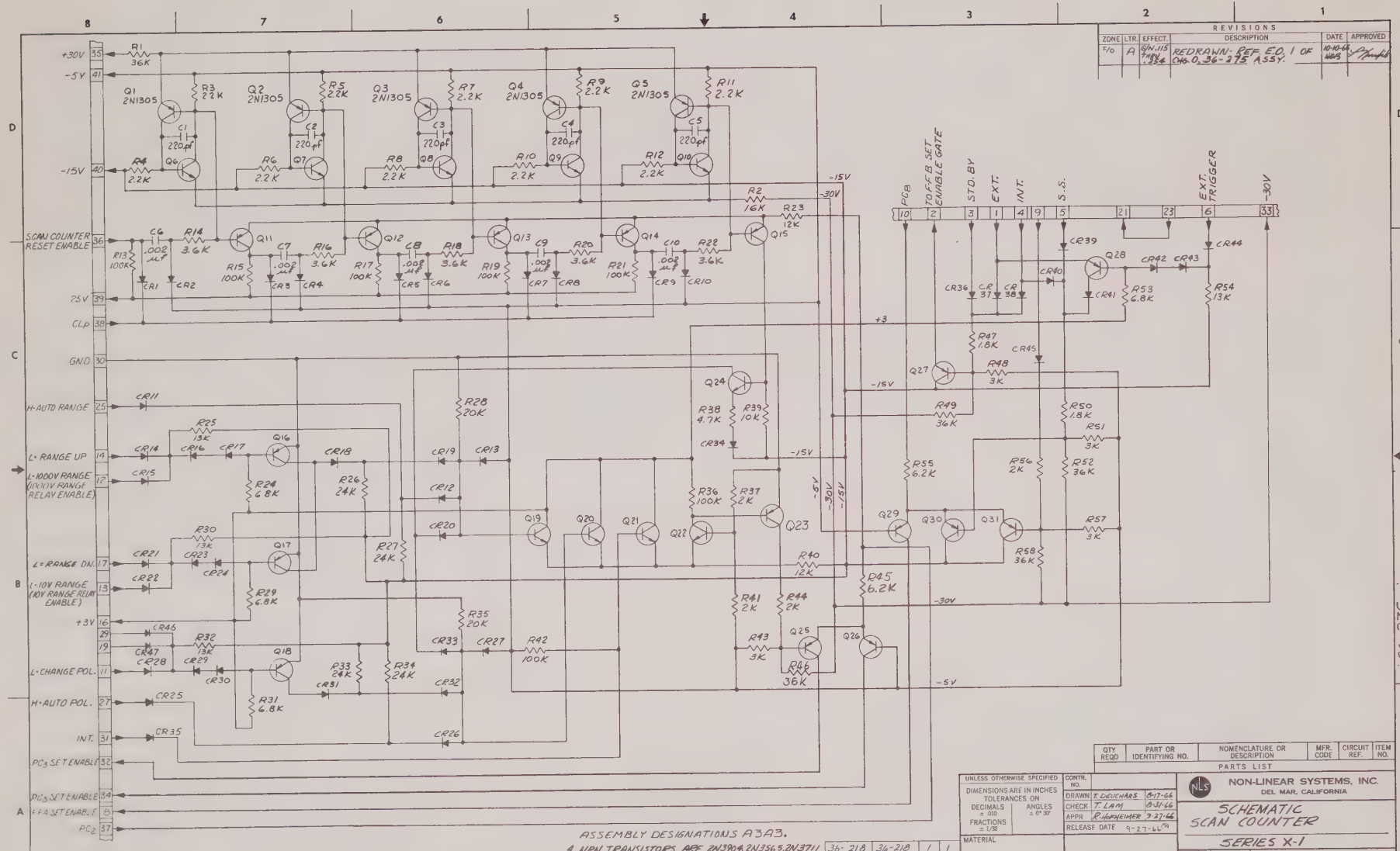
RANGE COUNTER SCHEMATIC

SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-272

SCALE | WEIGHT | SHEET 2 OF 2

36-272 SH 2



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
F/O	A	6/N-115 THRU 134	REDRAWN- REF E.O. 1 OF CHG. O. 36-275 A SSY.	10-10-66	

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

ASSEMBLY DESIGNATIONS A3A3.

4. NPN TRANSISTORS ARE 2N3904, 2N3565, 2N3711
3. PNP TRANSISTORS ARE 2N3906, 2N3638, 2N3702
2. DIODES ARE NLS 5003-002
1. RESISTORS ARE 1/4 W, 5% CARBON

NOTES: UNLESS OTHERWISE SPECIFIED

5. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATIONS WITH THE

APPLICATION	NEXT ASSY.	FINAL ASSY.	QTY. NEXT ASSY.	QTY. FINAL ASSY
	36-218	36-218	1	1
	36-205	36-205	1	1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

MATERIAL

CONTR. NO.

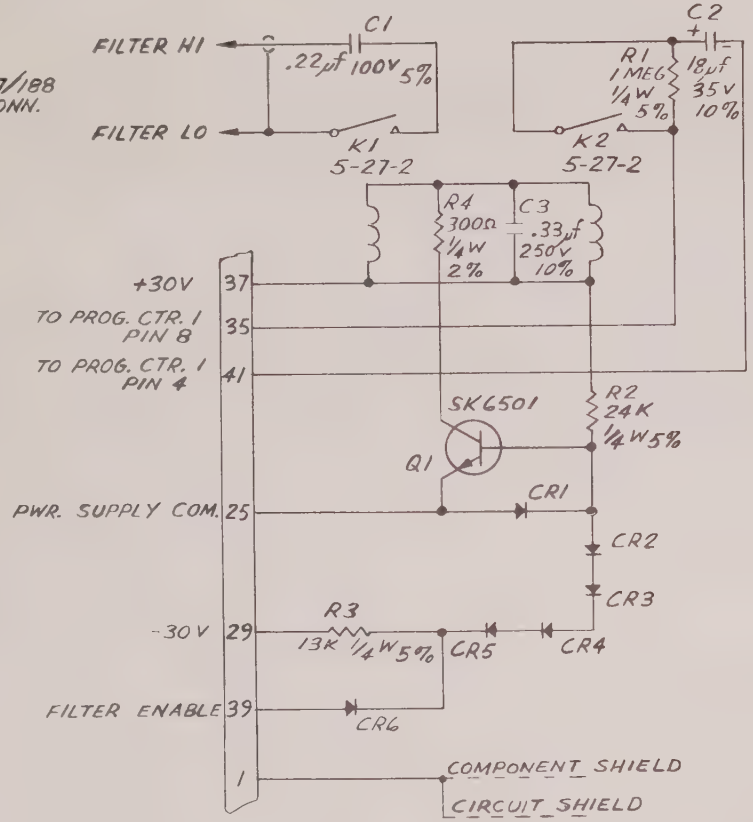
DRAWN	T. DEUCHARS	8-17-66
CHECK	T. LAM	8-31-66
APPR	R. HOFHEIMER	9-27-66
RELEASE DATE	9-27-66	

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC
SCAN COUNTER
SERIES X-1

SIZE D | CODE IDENT NO. 03626 | 36-275

SCALE | WEIGHT | SHEET 2 OF 2



36-296 SH2

REVISIONS					
ZONE	LTR	EFFECT.	DESCRIPTION	DATE	APPROVED

2. DIODES ARE NLS 5003-002.
1. REFERENCE DESIGNATIONS ARE ABBREVIATED SEE TOP ASS'Y. SCHEMATIC LIST.
NOTES: UNLESS OTHERWISE SPECIFIED.

NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
36-218	36-218	1	1
APPLICATION		QTY	

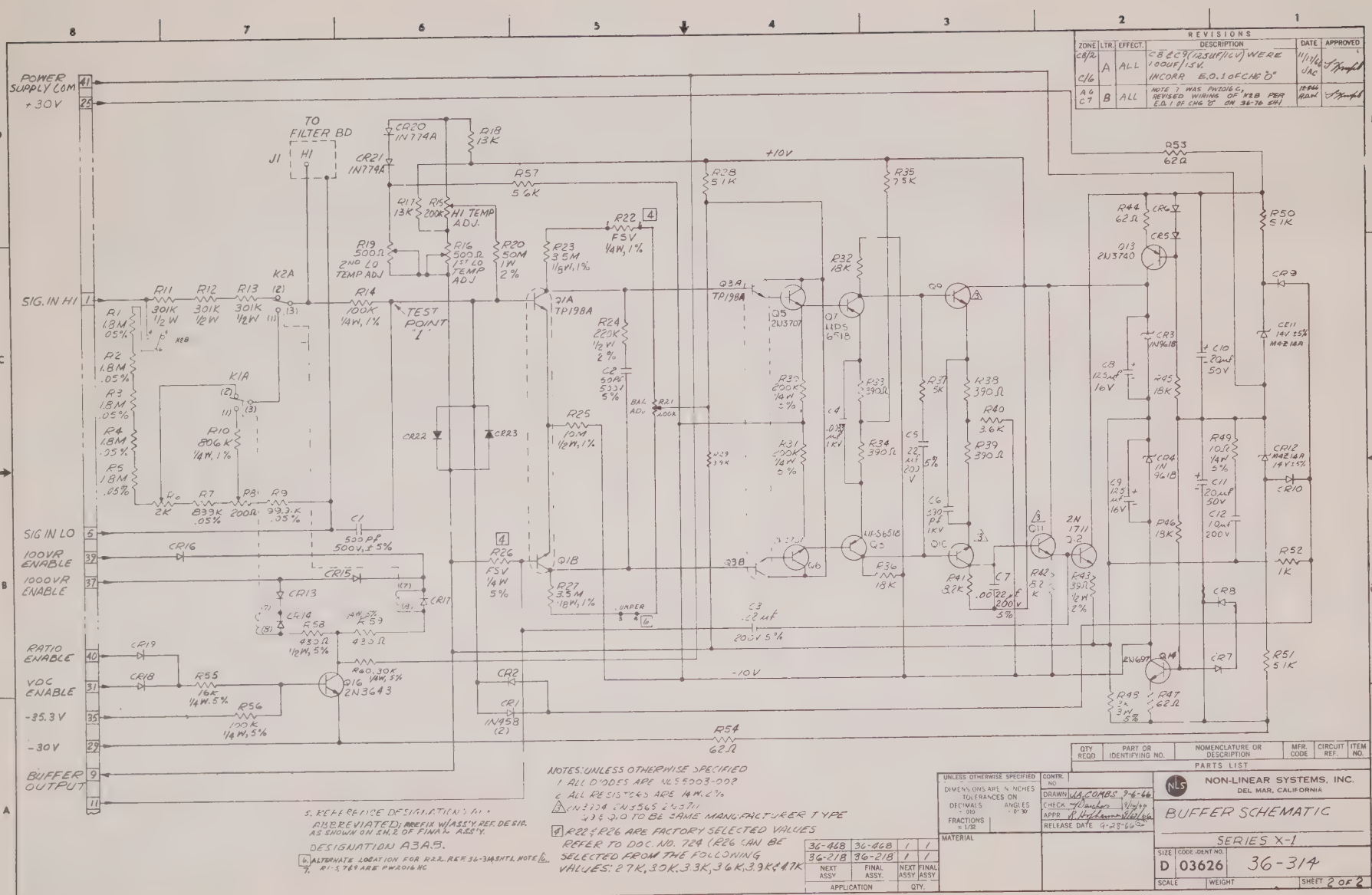
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

CONTR NO
DRAWN WICKLAND 8-26-66
CHECK
APPR
RELEASE DATE

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

FILTER ASSEMBLY SCHEMATIC

SIZE	CODE IDENT NO.	
B	03626	36-296
SCALE	WEIGHT	SHEET 2 OF 2



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
C8/2 C/6	A	ALL	C8 EC9(125UF/16V) WERE 100UF/15V. INCORR E.O.1 OF CHG "D"	11/14/66 LAC	
A6 C7	B	ALL	NOTE 7 WAS PW2016, REVISED WIRING OF M2B PER E.O.1 OF CHG "D" ON 36-76 SH1	12-8-66 RAM	

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIODES ARE IN5003-002
2. ALL RESISTORS ARE 1/4 W, 2%
3. 2N3704, 2N3565, 2N3711 ARE TO BE SAME MANUFACTURER TYPE
4. R22 & R26 ARE FACTORY SELECTED VALUES REFER TO DOC. NO. 729 (R26 CAN BE SELECTED FROM THE FOLLOWING VALUES: 27K, 30K, 33K, 36K, 39K & 47K
5. REFERENCE DESIGNATIONS A1 + ABBREVIATED; PREFIX W/ASS'Y REF. DESIG. AS SHOWN ON SH. 2 OF FINAL ASS'Y. DESIGNATION A3A3.
6. ALTERNATE LOCATION FOR R22, REF 36-314 SHT 1, NOTE 6.
7. R1-5, 7&9 ARE PW2016 NC

36-468	36-468	/	/
36-218	36-218	/	/
NEXT ASSY	FINAL ASSY.	NEXT ASSY	FINAL ASSY
APPLICATION		QTY.	

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ± .010 ANGLES ± 0° 30' FRACTIONS ± 1/32

MATERIAL

CONTR. NO.

DRAWN W.A. COMBS 9-6-66
CHECK
APPR
RELEASE DATE 9-28-66

NLS NON-LINEAR SYSTEMS, INC. DEL MAR, CALIFORNIA

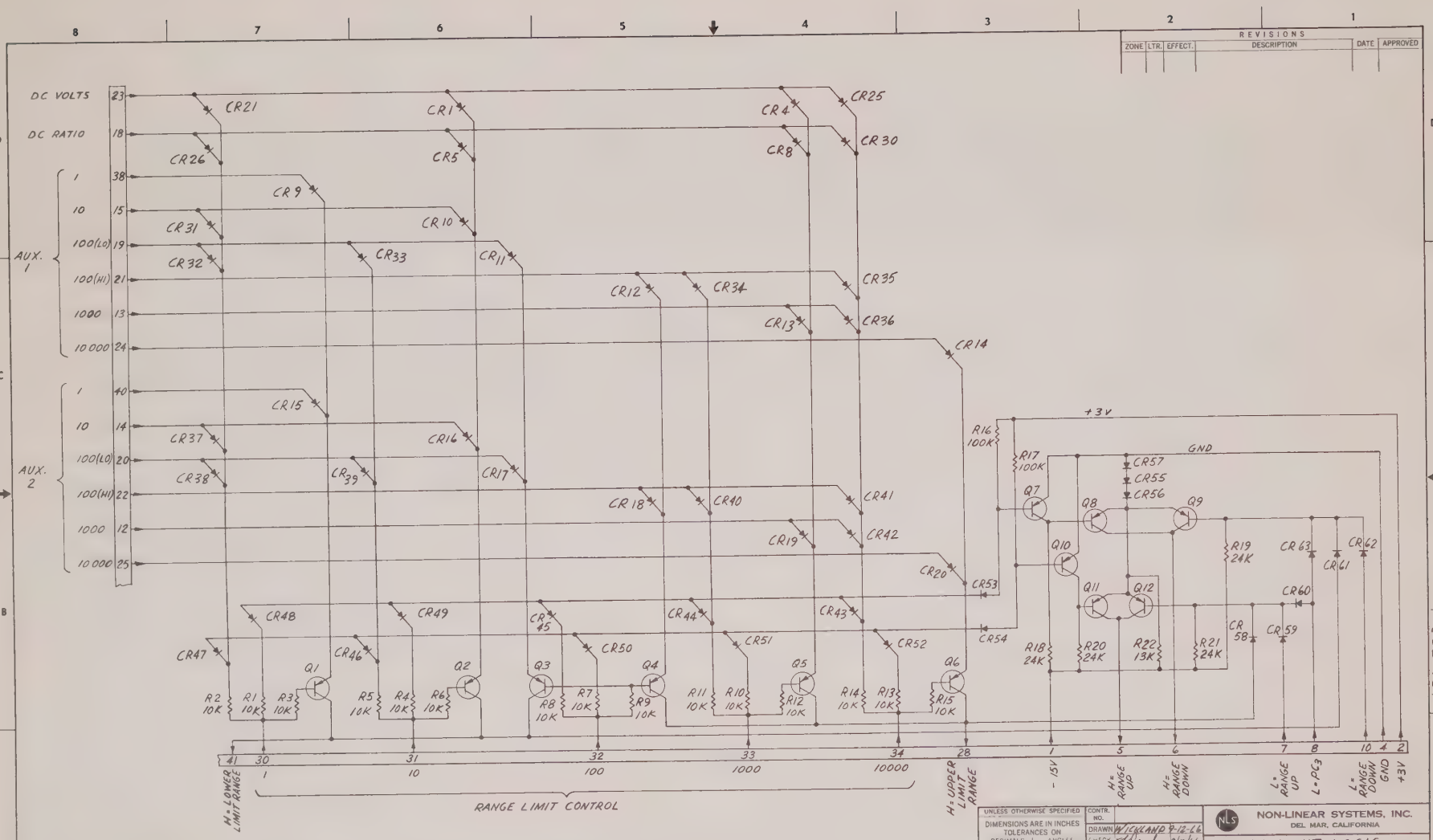
BUFFER SCHEMATIC

SERIES X-1

SIZE D | CODE IDENT NO. 03626 | 36-314

SCALE | WEIGHT | SHEET 2 OF 2

36-314 SH. 2



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

5 REF. DESIG. ARE ABBREV.; PREFIX WITH ASS'Y. DESIG. SHOWN ON SHEET 2 OF FINAL ASS'Y.
4 CIRCUIT REF. NO.S NOT USED: CR 2, 3, 6, 7, 22, 23, 24, 27, 28, & 29
3. PNP TRANSISTORS ARE 2N3906/3638A/2N3702.
2. RESISTORS ARE 1/4 W - CARBON - 5%
1. DIODES ARE NLS 5003-002.
NOTES: UNLESS OTHERWISE SPECIFIED

36-218 NEXT ASSY.	36-218 FINAL ASSY.	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010 ANGLES ± 0° 30'
FRACTIONS ~ 1/32

CONTR. NO.
DRAWN W. ICKLAND 7-12-66
CHECK [illegible] 7/19/66
APPR. [illegible] 7/11/66
RELEASE DATE
MATERIAL

D.C. VOLTS / D.C. RATIO: 10V LWR. RANGE; 1000V UPPER RANGE

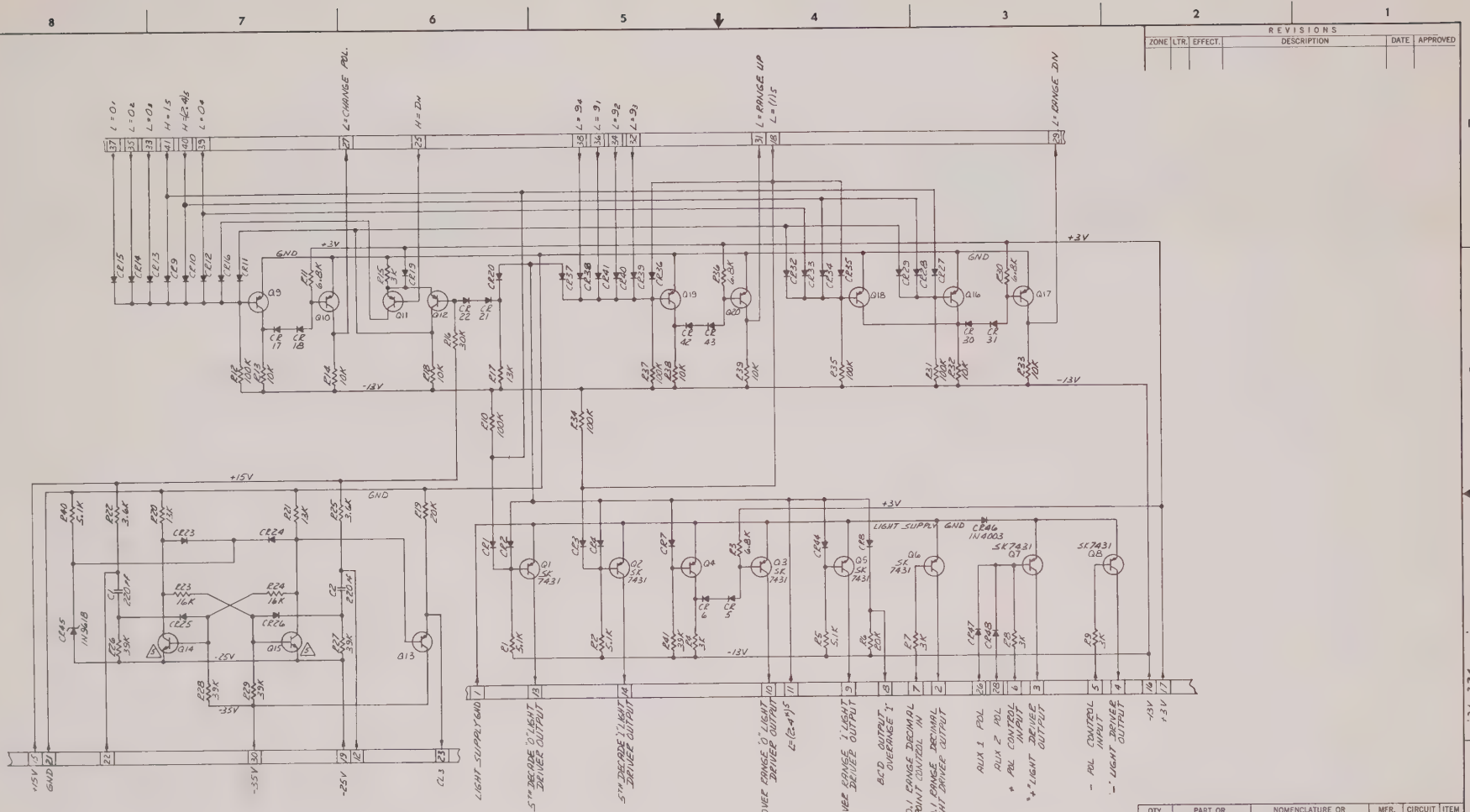
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

RANGE LIMIT LOGIC ASSEMBLY - SCHEMATIC -
SERIES X-1

SIZE	CODE IDENT NO	36-320
D	03626	

SCALE | WEIGHT | SHEET 2 OF 2

36-320 SH 2



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF	ITEM NO.

PARTS LIST

△5 ALL NPN TRANSISTORS ARE SK 6501/2N3904.
4 ALL PNP TRANSISTORS ARE 2N3906/2N3638A/2N3702
3. ALL DIODES NLS 5003-002.
2. ALL RESISTORS ¼W 5%
1. REF. DESIG. ARE ABBREV.; PREFIX WITH ASSY. DESIG. SHOWN ON SH.2 OF FINAL ASSY

NOTES; UNLESS OTHERWISE SPECIFIED

36-218	36-218	1	1
NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.
DRAWN Ray Deuchars 9-22-64
CHECK Tom Vu... 9-26-66
APPR H. Hellerman 9/30/66
RELEASE DATE 9-30-66 △5

MATERIAL

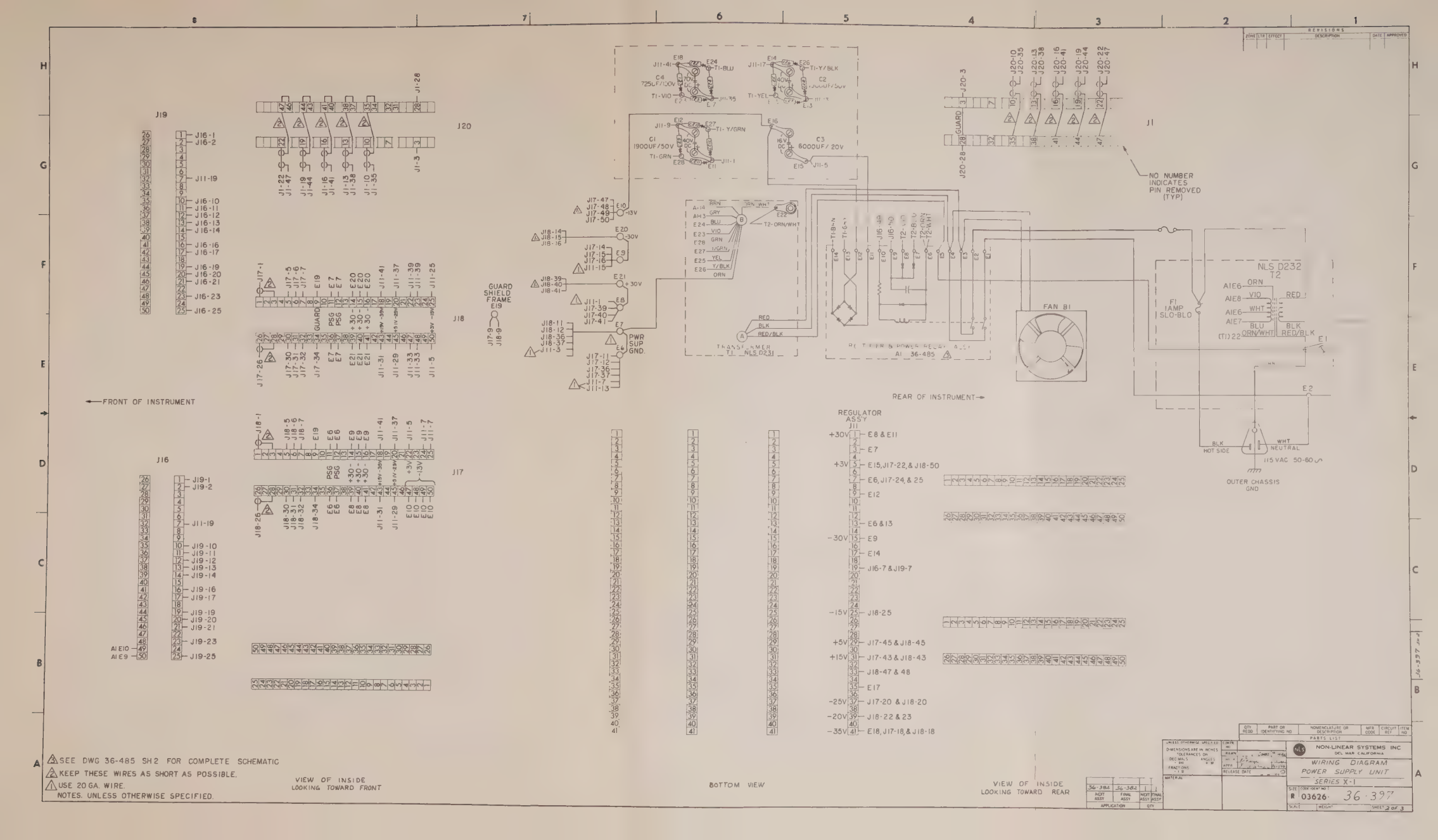
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC - RANGE DECISION LOGIC

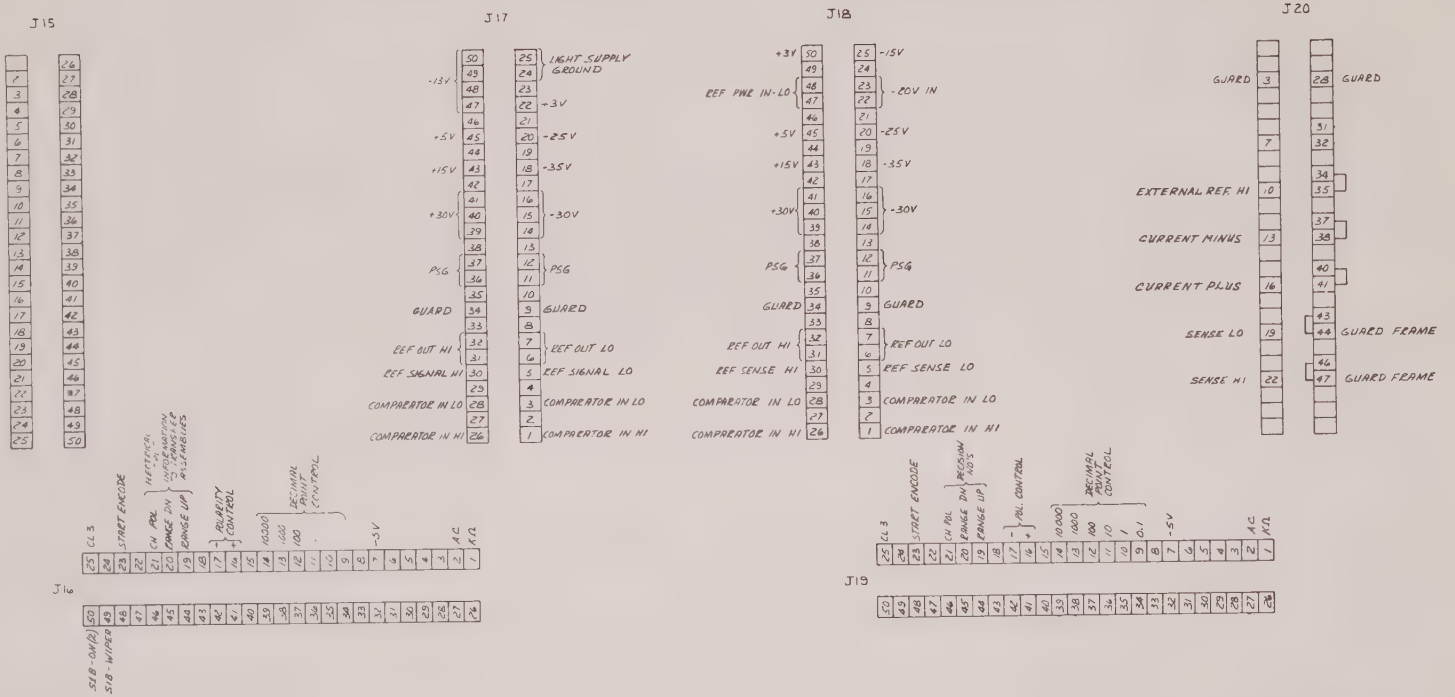
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-324
SCALE	WEIGHT	SHEET 2 OF 2

36-324 SH 2


J19
J20
J18
J17
J16
J1
J1-28
J1-22 J1-47
J1-19 J1-44
J1-16 J1-41
J1-13 J1-38
J1-10 J1-35
J1-3
GUARD SHIELD FRAME E19
J17-9
J18-9
J17-1
J17-5
J17-6
J17-7
J17-26
J17-30
J17-31
J17-32
J17-34
J18-1
J18-5
J18-6
J18-7
J18-26
J18-30
J18-31
J18-32
J18-34
J16-1
J16-2
J11-19
J16-10
J16-11
J16-12
J16-13
J16-14
J16-16
J16-17
J16-19
J16-20
J16-21
J16-23
J16-25
J19-1
J19-2
J19-10
J19-11
J19-12
J19-13
J19-14
J19-16
J19-17
J19-19
J19-20
J19-21
J19-23
J19-25
AIE10
AIE9
J11-41
J11-37
J11-5
J11-7
J11-39
J11-25
J11-33
J11-31
J11-29
E19
E7
E20
E21
E6
E8
E9
E10
+30V
+3V
-13V
-30V
-25V
+5V
GUARD
PSG
FRONT OF INSTRUMENT
E18
E24
J11-41
T1-BLU
C4
725UF/30V
T1-VIO
E14
E26
J11-17
T1-Y/BLK
C2
T1-YEL
E12
E27
J11-9
T1-Y/GRN
C1
1900UF/50V
T1-GRN
E16
C3
6000UF/ 20V
E15
J11-5
E28
E11
J11-1
J17-47
J17-48
J17-49
J17-50
E10
-13V
J18-14
J18-15
J18-16
E20
-30V
J17-14
J17-15
J17-16
J11-15
E9
J18-39
J18-40
J18-41
E21
+30V
J11-1
J17-39
J17-40
J17-41
E8
J18-11
J18-12
J18-36
J18-37
J11-3
J17-11
J17-12
J17-36
J17-37
J11-7
J11-13
E7
E6
PWR SUP GND.
TRANSFORMER T1 NLS 0231
RECTIFIER & POWER RELAY ASSY A1 36-485
A-14 GRN
AH3 GRY
E24 BLU
E23 VIO
E28 GRN
E27 T/GRN
E25 YEL
E26 Y/BLK
ORN
GRN/WHT
E22
T2-ORN/WHT
REG
BLK
RED/BLK
T1-B-N
T1-G-N
T2-ORN
T2-GRN
T2-WHT
J16-10
J16-9
J16-8
J16-7
J16-6
J16-5
J16-4
J16-3
J16-2
J16-1
E14
E13
E12
E11
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
FAN B1
F1
1AMP
SLO-BLO
NLS D232
T2
AIE6 ORN
AIE8 VIO
AIE6 WHT
AIE7 BLU
(T1) 22 ORN/WHT
RED
BLK
RED/BLK
E1
E2
BLK
HOT SIDE
WHT
NEUTRAL
115 VAC 50-60~
OUTER CHASSIS GND
J20-3
J20-10
J20-35
J20-13
J20-38
J20-16
J20-41
J20-19
J20-44
J20-22
J20-47
J20-28
NO NUMBER INDICATES PIN REMOVED (TYP)
REAR OF INSTRUMENT
REGULATOR ASSY J11
+30V E8 & E11
E7
+3V E15, J17-22, & J18-50
E6, J17-24, & 25
E12
E6 & 13
-30V E9
E14
J16-7 & J19-7
-15V J18-25
+5V J17-45 & J18-45
+15V J17-43 & J18-43
J18-47 & 48
E17
-25V J17-20 & J18-20
-20V J18-22 & 23
-35V E18, J17-18, & J18-18
VIEW OF INSIDE LOOKING TOWARD FRONT
BOTTOM VIEW
VIEW OF INSIDE LOOKING TOWARD REAR
SEE DWG 36-485 SH2 FOR COMPLETE SCHEMATIC
KEEP THESE WIRES AS SHORT AS POSSIBLE.
USE 20 GA. WIRE.
NOTES. UNLESS OTHERWISE SPECIFIED.
REVISIONS
ZONE | LTR | EFFECT | DESCRIPTION | DATE | APPROVED
QTY REQD | PART OR IDENTIFYING NO | NOMENCLATURE OR DESCRIPTION | MFR CODE | CIRCUIT REF | ITEM NO
PARTS LIST
NON-LINEAR SYSTEMS INC
DEL MAR CALIFORNIA
WIRING DIAGRAM
POWER SUPPLY UNIT
SERIES X-1
SIZE R
CODE IDENT NO 03626
DWG NO 36-397
SCALE
WEIGHT
SHEET 2 OF 3
36-384
36-382
NEXT ASSY
FINAL ASSY
NEXT HIGHER ASSY
APPLICATION
QTY
36-397 sh2

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED



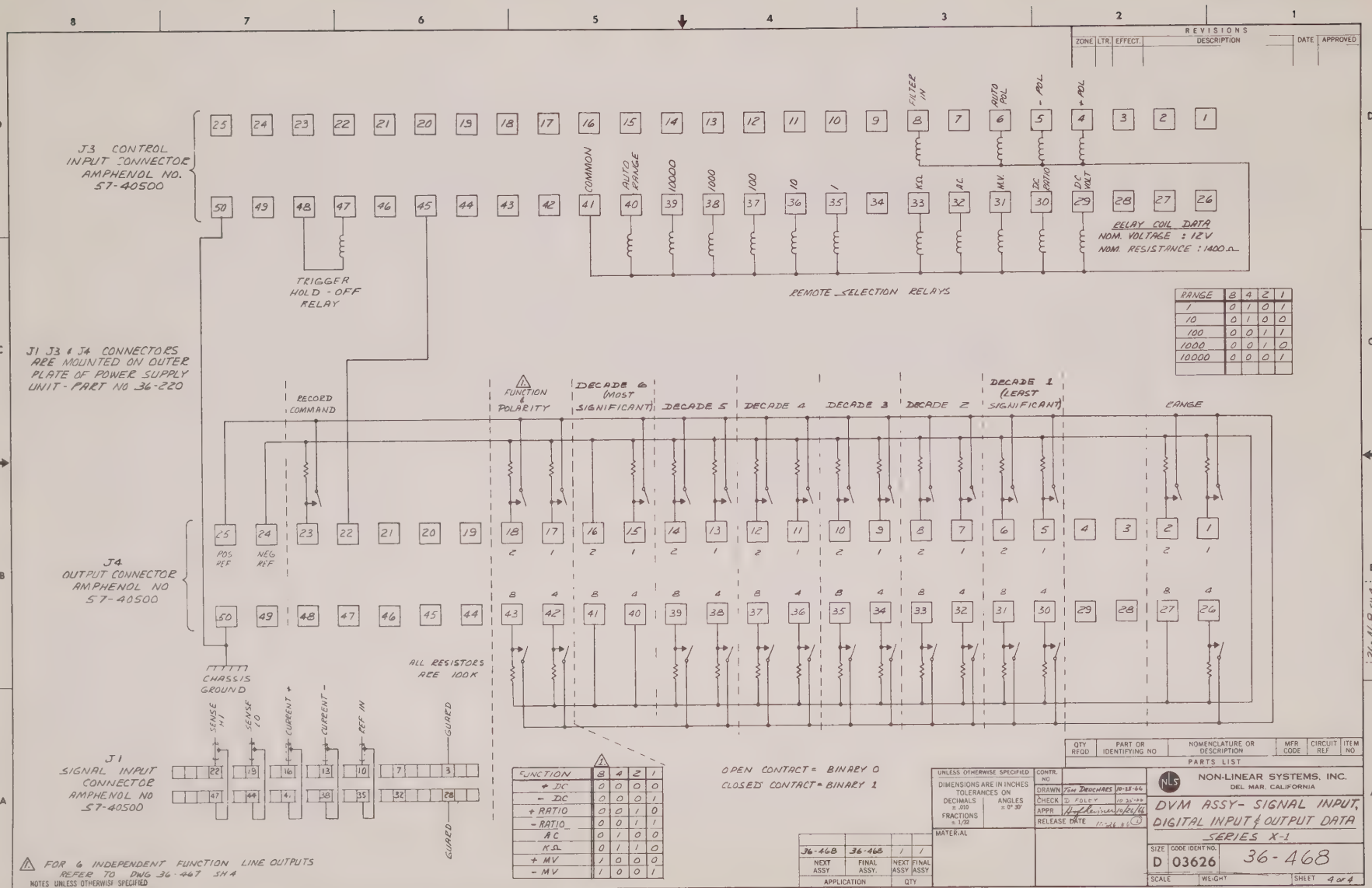
VIEW OF CONNECTORS FROM OUTSIDE

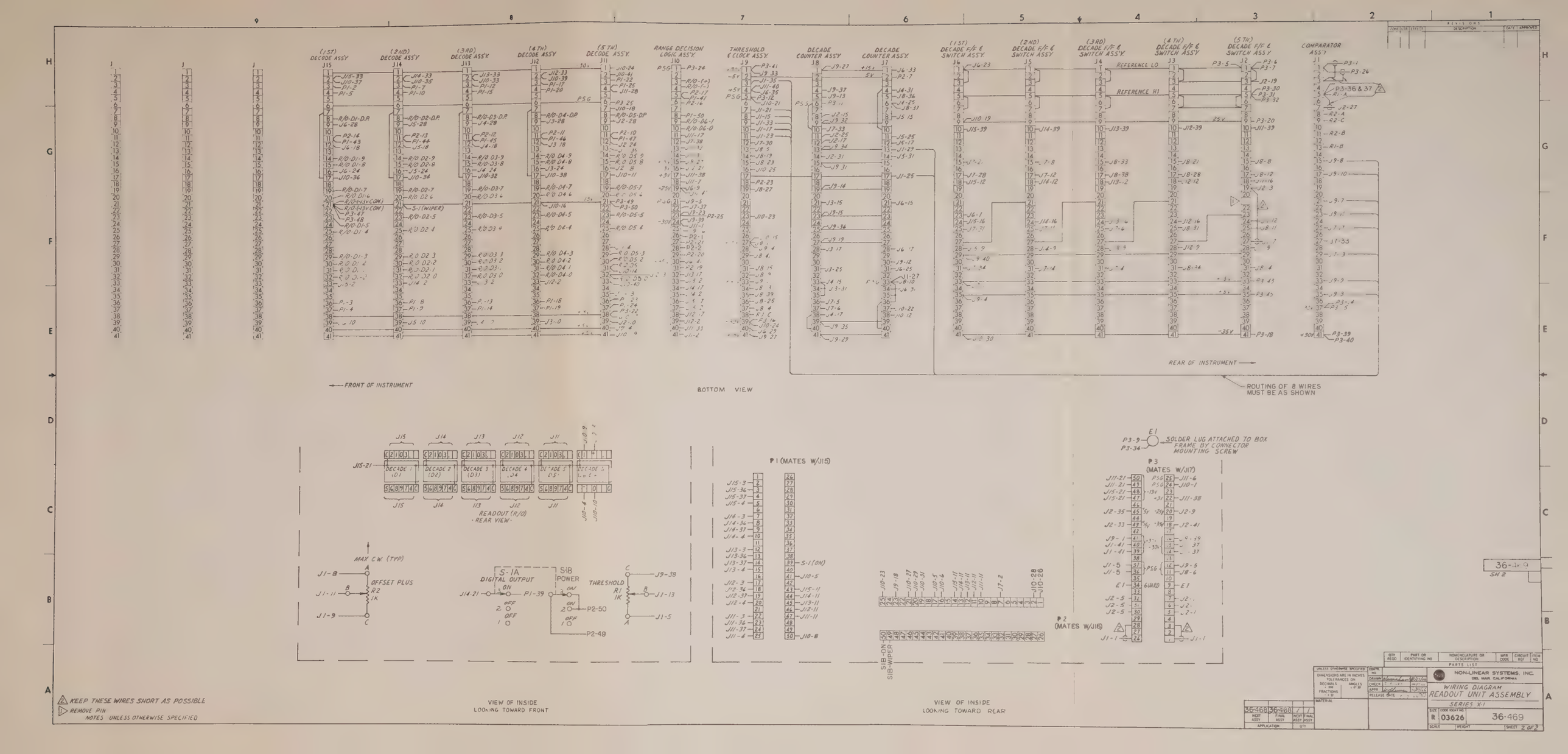
QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED	CONTR. NO	NON-LINEAR SYSTEMS, INC. DEL MAR, CALIFORNIA
DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ± .010 FRACTIONS ± 1/32 ANGLES ± 0° 30'	DRAWN J A COMBS 12-21-66 CHECK 12-21-66 APPR 12-22-66 RELEASE DATE	CONNECTOR PIN DESIGNATIONS INTERNAL SERIES X-1
MATERIAL		SIZE D CODE IDENT NO. 03626 — 36-397
36-382 NEXT ASSY. / 36-382 FINAL ASSY. / 1 NEXT ASSY / 1 FINAL ASSY		SCALE — WEIGHT — SHEET 3 OF 3
APPLICATION — QTY.		

36-397 SH 3


REVISIONS
ZONE | LTR | EFFECT. | DESCRIPTION | DATE | APPROVED
J3 CONTROL INPUT CONNECTOR AMPHENOL NO. 57-40500
25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26
COMMON
AUTO RANGE
10000
1000
100
10
1
FILTER IN
AUTO POL
- POL
+ POL
KΩ
AC
MV
DC RATIO
DC VOLT
TRIGGER HOLD - OFF RELAY
REMOTE SELECTION RELAYS
RELAY COIL DATA
NOM. VOLTAGE : 12V
NOM. RESISTANCE : 1400Ω
RANGE | 8 | 4 | 2 | 1
1 | 0 | 1 | 0 | 1
10 | 0 | 1 | 0 | 0
100 | 0 | 0 | 1 | 1
1000 | 0 | 0 | 1 | 0
10000 | 0 | 0 | 0 | 1
J1 J3 & J4 CONNECTORS ARE MOUNTED ON OUTER PLATE OF POWER SUPPLY UNIT - PART NO 36-220
RECORD COMMAND
FUNCTION & POLARITY
DECADE 6 (MOST SIGNIFICANT)
DECADE 5
DECADE 4
DECADE 3
DECADE 2
DECADE 1 (LEAST SIGNIFICANT)
RANGE
J4 OUTPUT CONNECTOR AMPHENOL NO 57-40500
25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
POS REF
NEG REF
8 4 2 1
50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26
8 4
CHASSIS GROUND
ALL RESISTORS ARE 100K
J1 SIGNAL INPUT CONNECTOR AMPHENOL NO 57-40500
SENSE HI
SENSE LO
CURRENT +
CURRENT -
REF IN
GUARD
GUARD
22 19 16 13 10 7 3
47 44 41 38 35 32 28
FUNCTION | 8 | 4 | 2 | 1
+ DC | 0 | 0 | 0 | 0
- DC | 0 | 0 | 0 | 1
+ RATIO | 0 | 0 | 1 | 0
- RATIO | 0 | 0 | 1 | 1
AC | 0 | 1 | 0 | 0
KΩ | 0 | 1 | 1 | 0
+ MV | 1 | 0 | 0 | 0
- MV | 1 | 0 | 0 | 1
OPEN CONTACT = BINARY 0
CLOSED CONTACT = BINARY 1
FOR 6 INDEPENDENT FUNCTION LINE OUTPUTS REFER TO DWG 36-467 SH 4
NOTES UNLESS OTHERWISE SPECIFIED
QTY REQD | PART OR IDENTIFYING NO | NOMENCLATURE OR DESCRIPTION | MFR CODE | CIRCUIT REF | ITEM NO
PARTS LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ± .010 FRACTIONS ± 1/32 ANGLES ± 0° 30'
CONTR NO
DRAWN Tim Deschaines 10-18-66
CHECK D. Foley 10-25-66
APPR Applegarth 10/26/66
RELEASE DATE 11-26-66
MATERIAL
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA
DVM ASSY- SIGNAL INPUT, DIGITAL INPUT & OUTPUT DATA
SERIES X-1
SIZE D | CODE IDENT NO. 03626 | 36-468
SCALE | WEIGHT | SHEET 4 of 4
36-468 | 36-468 | / | /
NEXT ASSY | FINAL ASSY | NEXT ASSY | FINAL ASSY
APPLICATION | QTY
36-468 SH 4



KEEP THESE WIRES SHORT AS POSSIBLE

REMOVE PIN

NOTES UNLESS OTHERWISE SPECIFIED

36-469
SH 2

ITEM NO	CIRCUIT REF	MFR CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	QTY REQD

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON DECIMALS .XX ±.02, FRACTIONS ±1/32, ANGLES ±1°

MATERIAL

CONTR NO
DRAWN
CHECK
APPD
RELEASE DATE

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

WIRING DIAGRAM
READOUT UNIT ASSEMBLY
SERIES X-1

NEXT ASSY	FINAL ASSY	INCRT'PANEL ASSY ASSY
36-468	36-468	/ /
APPLICATION		QTY

SIZE R | CODE IDENT NO. 03626 | 36-469

SCALE | WEIGHT | SHEET 2 OF 2

MODIFICATION DATA
SERIES X-1 DIGITAL VOLTMETER

USING THE SERIES X-1 DVM WITH A HEWLETT-PACKARD 562A DIGITAL RECORDER

1. For operation with the Series X-1 DVM, the Hewlett-Packard Recorder should be procured with options 22 (plug-in boards) and 30 (cable).

2. Modify the Recorder as follows:

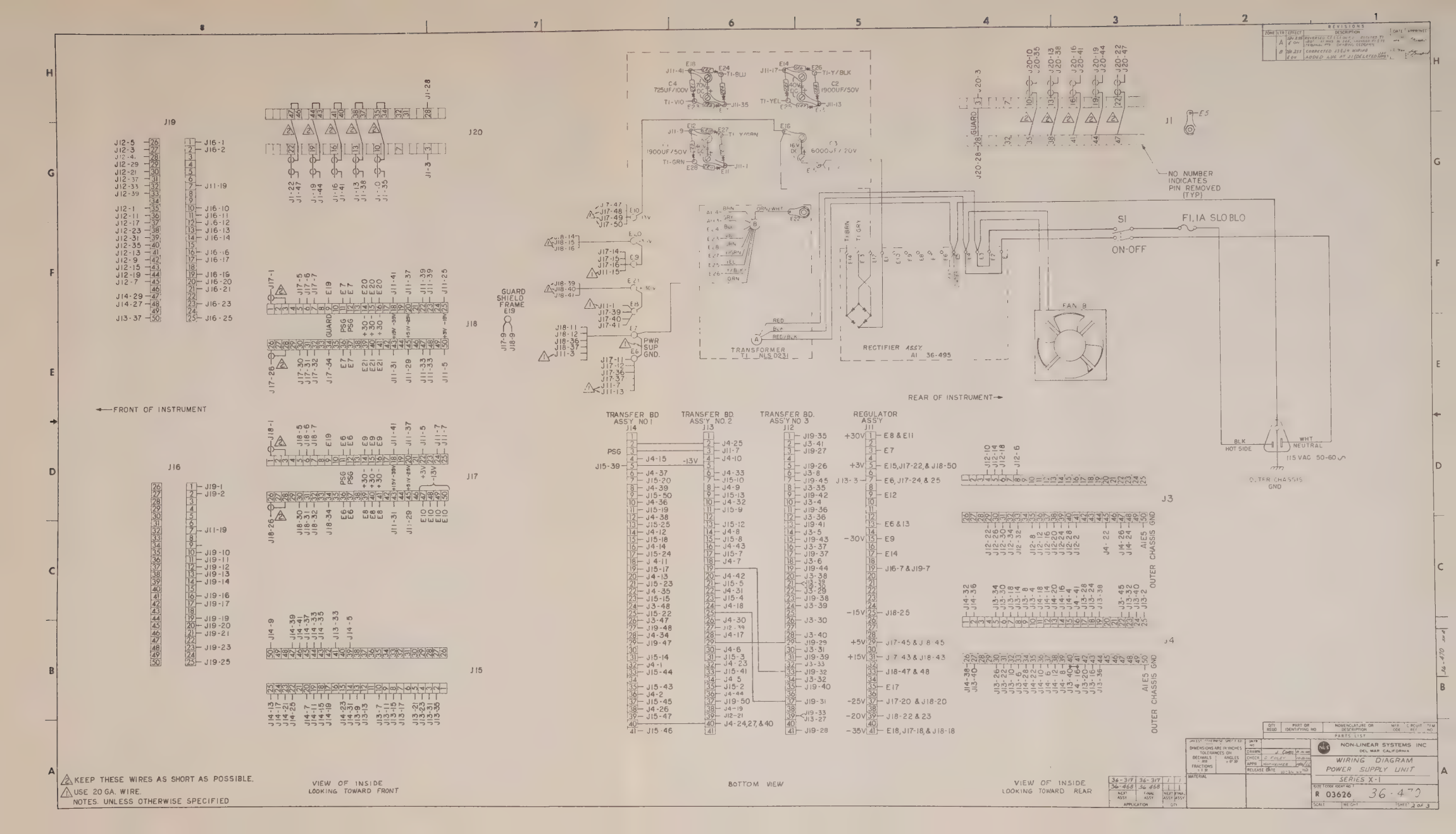
   a. Add a jumper from the +16-volt supply to pin 1 and from the -9-volt supply to pin 2 of the 6-pin output connector nearest the center of the Power Supply Board (A16).

   b. Change resistor R4 on the Control Board (A13) from 1000 ohms to 500 ohms.

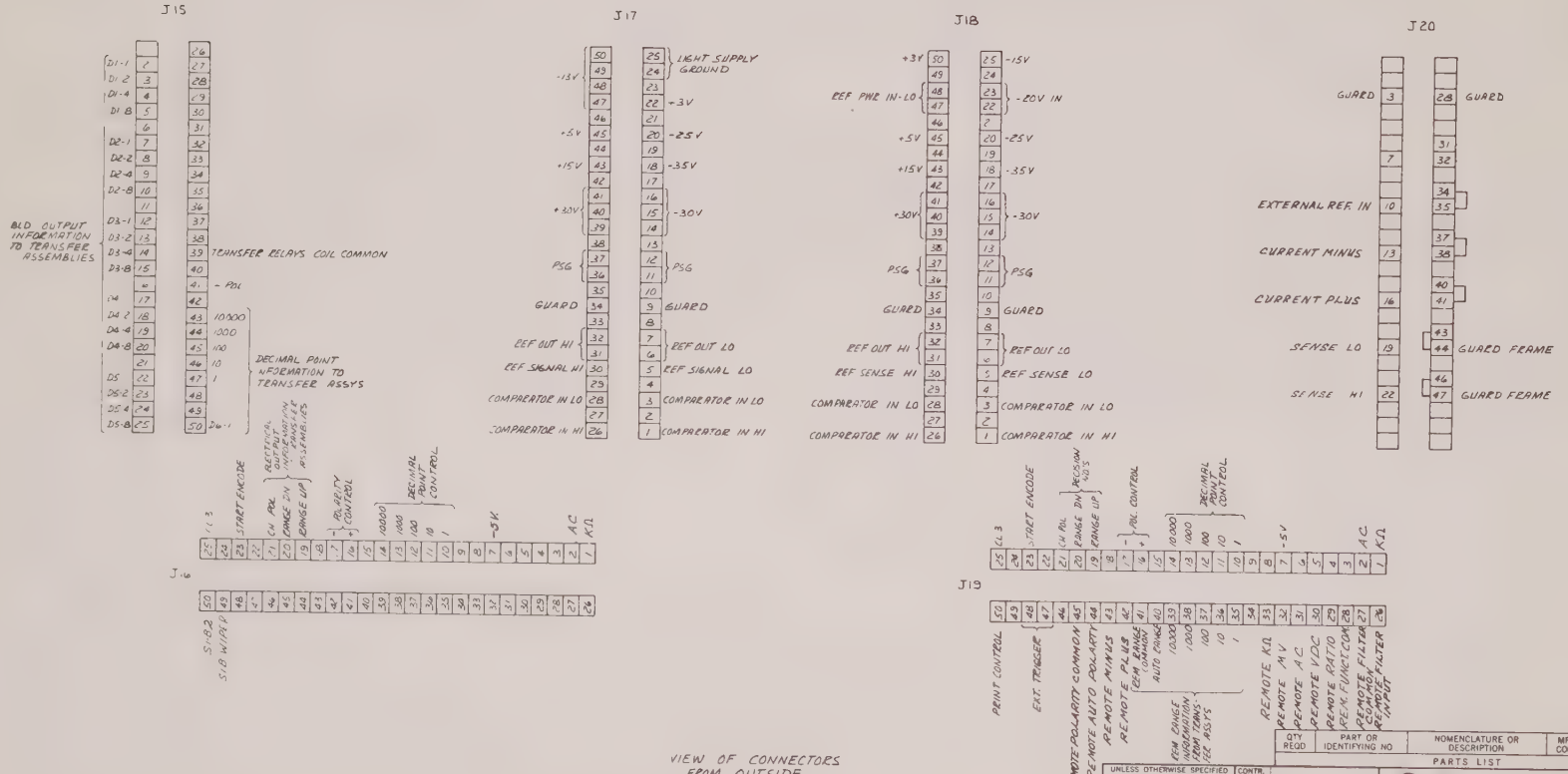
   c. Connect the black 6-pin connector socket No. 2 to the Power Supply Board connector which is nearest to the center of the board (see the Recorder instruction manual for location of boards, pins, components, etc.).

3. For Recorder operation, connect the Recorder cable to connector J4 of the X-1 DVM.

4. If the Recorder is to control the triggering of the X-1 (closed loop operation), jumper pin 45 to pin 47 and pin 48 to pin 50 of connector J3 of the X-1 DVM.


REVISIONS
DESCRIPTION
NO NUMBER INDICATES PIN REMOVED (TYP)
SI
FI,IA SLO BLO
ON-OFF
BLK HOT SIDE
WHT NEUTRAL
115 VAC 50-60 ~
OUTER CHASSIS GND
FAN B
TRANSFORMER T1 NLS 0231
RECTIFIER ASSY A1 36-495
REAR OF INSTRUMENT
FRONT OF INSTRUMENT
GUARD SHIELD FRAME E19
PWR SUP GND.
TRANSFER BD ASSY NO 1 J14
TRANSFER BD ASS'Y NO. 2 J13
TRANSFER BD. ASS'Y NO 3 J12
REGULATOR ASS'Y J11
+30V
+3V
-30V
-15V
+5V
+15V
-25V
-20V
-35V
J1
J2
J3
J4
J15
J16
J17
J18
J19
J20
KEEP THESE WIRES AS SHORT AS POSSIBLE.
USE 20 GA. WIRE.
NOTES. UNLESS OTHERWISE SPECIFIED
VIEW OF INSIDE LOOKING TOWARD FRONT
BOTTOM VIEW
VIEW OF INSIDE LOOKING TOWARD REAR
PARTS LIST
NON-LINEAR SYSTEMS INC
DEL MAR CALIFORNIA
WIRING DIAGRAM
POWER SUPPLY UNIT
SERIES X-1
R 03626
36-472
SHEET 2 OF 3

REVISIONS					
ZONE	LTR	EFFECT	DESCRIPTION	DATE	APPROVED
	A	ALL	ADDED "GUARD" TO J17-34 AND CHGD. -5V FROM J16-5 TO J16-7	1-12-67	



VIEW OF CONNECTORS FROM OUTSIDE

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

CONTR. NO
DRAWN J.A COMBS 10-28-66
CHECK D POLK 10-28-66
APPR
RELEASE DATE
MATERIAL

NEXT ASSY	FINAL ASSY.	NEXT ASSY	FINAL ASSY
36-468	36-468	1	1
APPLICATION		QTY	

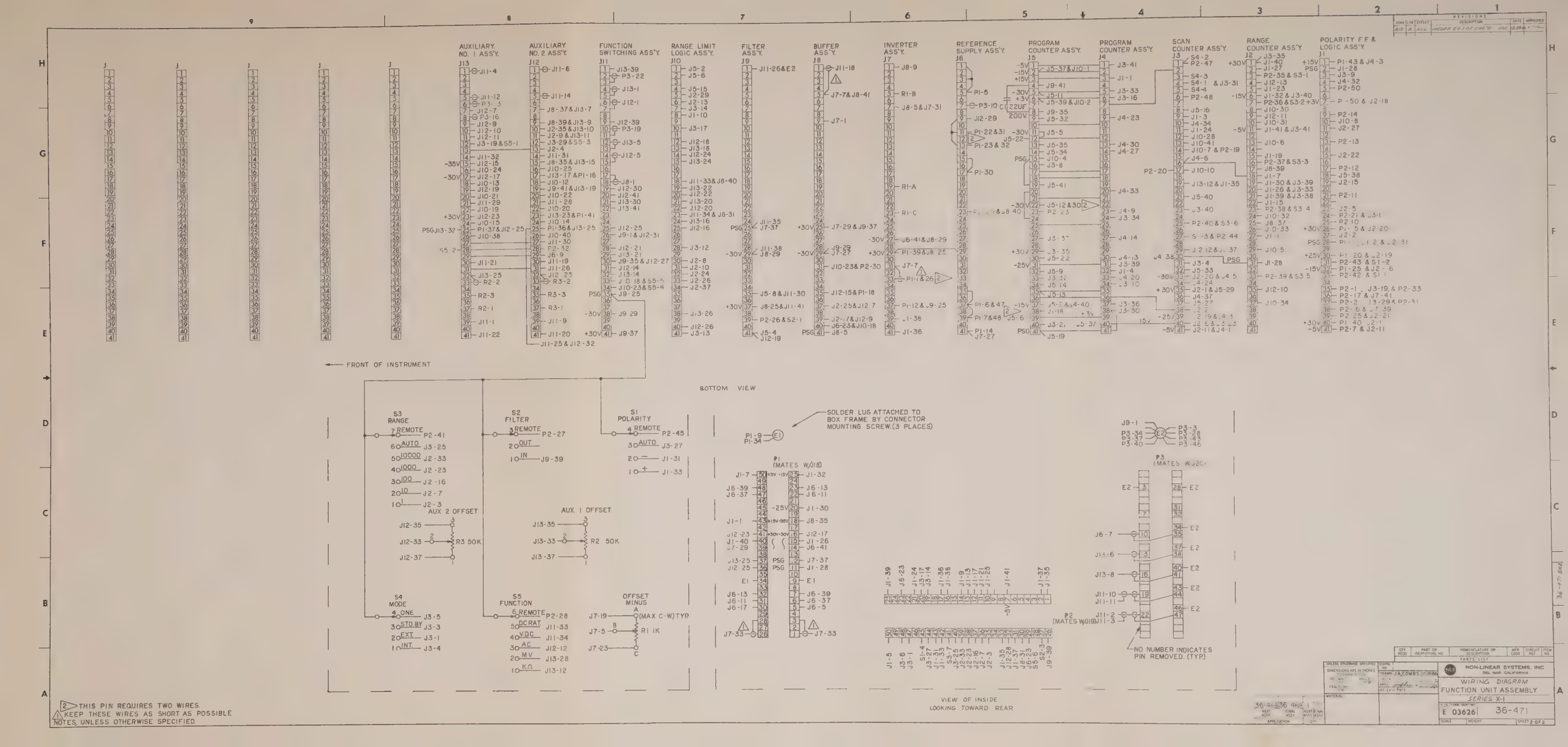
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

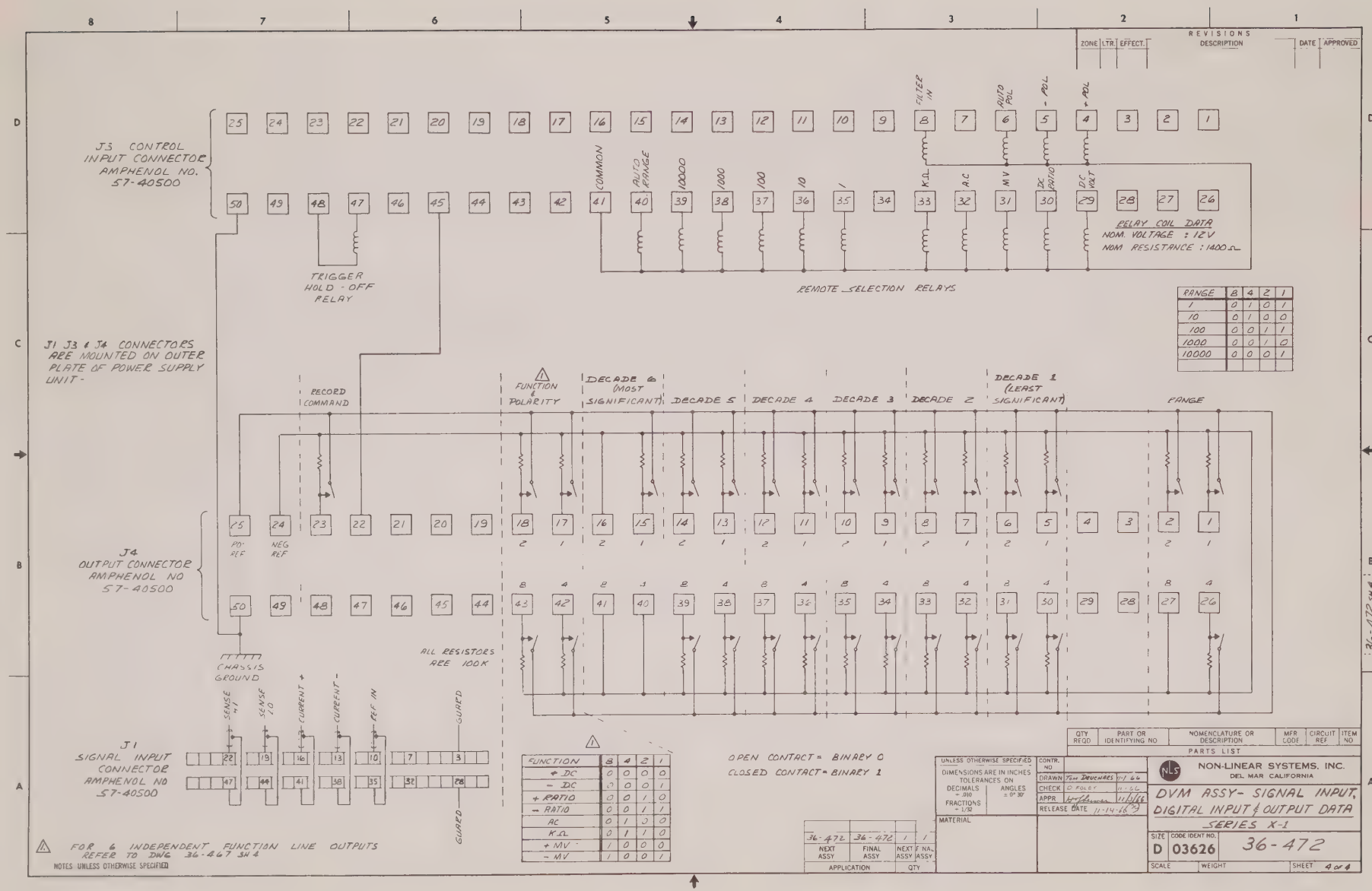
CONNECTOR PIN DESIGNATIONS INTERNAL

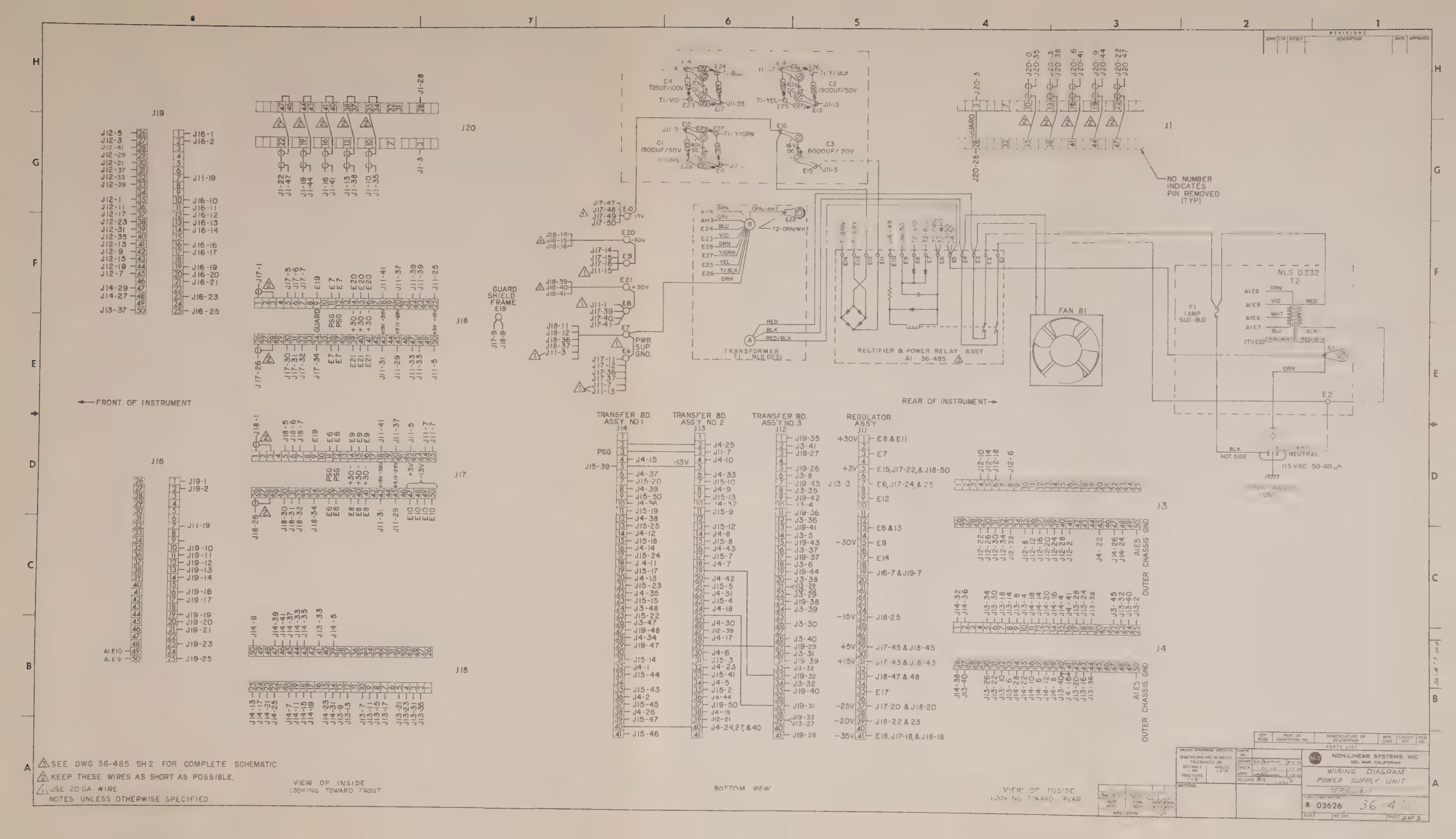
SERIES X-1

SIZE	CODE IDENT NO	
D	03626	36-470
SCALE	WEIGHT	SHEET 3 OF 3

36-470 SH 3


AUXILIARY NO. 1 ASS'Y.
AUXILIARY NO. 2 ASS'Y.
FUNCTION SWITCHING ASS'Y.
RANGE LIMIT LOGIC ASS'Y.
FILTER ASS'Y.
BUFFER ASS'Y.
INVERTER ASS'Y.
REFERENCE SUPPLY ASS'Y.
PROGRAM COUNTER ASS'Y.
PROGRAM COUNTER ASS'Y.
SCAN COUNTER ASS'Y.
RANGE COUNTER ASS'Y.
POLARITY F.F. & LOGIC ASS'Y.
FRONT OF INSTRUMENT
BOTTOM VIEW
S3 RANGE
S2 FILTER
S1 POLARITY
S4 MODE
S5 FUNCTION
AUX 2 OFFSET
AUX. 1 OFFSET
OFFSET MINUS
SOLDER LUG ATTACHED TO BOX FRAME BY CONNECTOR MOUNTING SCREW.(3 PLACES)
P1 (MATES W/J18)
P2 (MATES W/J19)
P3 (MATES W/J20)
NO NUMBER INDICATES PIN REMOVED. (TYP.)
VIEW OF INSIDE LOOKING TOWARD REAR
THIS PIN REQUIRES TWO WIRES.
KEEP THESE WIRES AS SHORT AS POSSIBLE
NOTES, UNLESS OTHERWISE SPECIFIED.
NON-LINEAR SYSTEMS, INC.
DEL MAR CALIFORNIA
WIRING DIAGRAM
FUNCTION UNIT ASSEMBLY
SERIES X-1
E 03626
36-471
SHEET 2 OF 2


REVISIONS
ZONE | LTR | EFFECT | DESCRIPTION | DATE | APPROVED
J3 CONTROL INPUT CONNECTOR AMPHENOL NO. 57-40500
25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26
COMMON
AUTO RANGE
10000
1000
100
10
1
K Ω
A C
M V
DC RATIO
DC VOLT
FILTER IN
AUTO ADJ
- ADJ
+ ADJ
RELAY COIL DATA
NOM. VOLTAGE : 12V
NOM RESISTANCE : 1400 Ω
TRIGGER HOLD - OFF RELAY
REMOTE SELECTION RELAYS
J1 J3 & J4 CONNECTORS ARE MOUNTED ON OUTER PLATE OF POWER SUPPLY UNIT -
RANGE | 8 | 4 | 2 | 1
1 | 0 | 1 | 0 | 1
10 | 0 | 1 | 0 | 0
100 | 0 | 0 | 1 | 1
1000 | 0 | 0 | 1 | 0
10000 | 0 | 0 | 0 | 1
RECORD COMMAND
FUNCTION & POLARITY
DECADE 6 (MOST SIGNIFICANT)
DECADE 5
DECADE 4
DECADE 3
DECADE 2
DECADE 1 (LEAST SIGNIFICANT)
RANGE
J4 OUTPUT CONNECTOR AMPHENOL NO 57-40500
25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
PO REF
NEG REF
2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1
8 4 2 1 8 4 8 4 8 4 8 4 8 4 8 4 8 4
50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 50 29 28 27 26
CHASSIS GROUND
ALL RESISTORS ARE 100K
J1 SIGNAL INPUT CONNECTOR AMPHENOL NO 57-40500
SENSE +/I
SENSE -/O
CURRENT +
CURRENT -
REF IN
GUARD
22 19 16 13 10 7 3
47 44 41 38 35 32 28
GUARD
FUNCTION | 8 | 4 | 2 | 1
+ DC | 0 | 0 | 0 | 0
- DC | 0 | 0 | 0 | 1
+ RATIO | 0 | 0 | 1 | 0
- RATIO | 0 | 0 | 1 | 1
AC | 0 | 1 | 0 | 0
K Ω | 0 | 1 | 1 | 0
+ MV | 1 | 0 | 0 | 0
- MV | 1 | 0 | 0 | 1
OPEN CONTACT = BINARY 0
CLOSED CONTACT = BINARY 1
FOR 6 INDEPENDENT FUNCTION LINE OUTPUTS REFER TO DWG 36-447 SH 4
NOTES: UNLESS OTHERWISE SPECIFIED
QTY REQD | PART OR IDENTIFYING NO | NOMENCLATURE OR DESCRIPTION | MFR CODE | CIRCUIT REF | ITEM NO
PARTS LIST
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ± .010 FRACTIONS ± 1/32 ANGLES ± 0° 30'
CONTR NO
DRAWN Tom Deuchars 11-1-66
CHECK D FOLEY 11-1-66
APPR 11/3/66
RELEASE DATE 11-14-66
MATERIAL
36-472 | 36-472 | 1 | 1
NEXT ASSY | FINAL ASSY | NEXT ASSY | F NA ASSY
APPLICATION | QTY
NON-LINEAR SYSTEMS, INC.
DEL MAR CALIFORNIA
DVM ASSY- SIGNAL INPUT, DIGITAL INPUT & OUTPUT DATA
SERIES X-1
SIZE D | CODE IDENT NO. 03626 | 36-472
SCALE | WEIGHT | SHEET 4 of 4
36-472 SH 4



⚠ SEE DWG 36-485 SH2 FOR COMPLETE SCHEMATIC

⚠ KEEP THESE WIRES AS SHORT AS POSSIBLE.

⚠ USE 20 GA WIRE

NOTES UNLESS OTHERWISE SPECIFIED

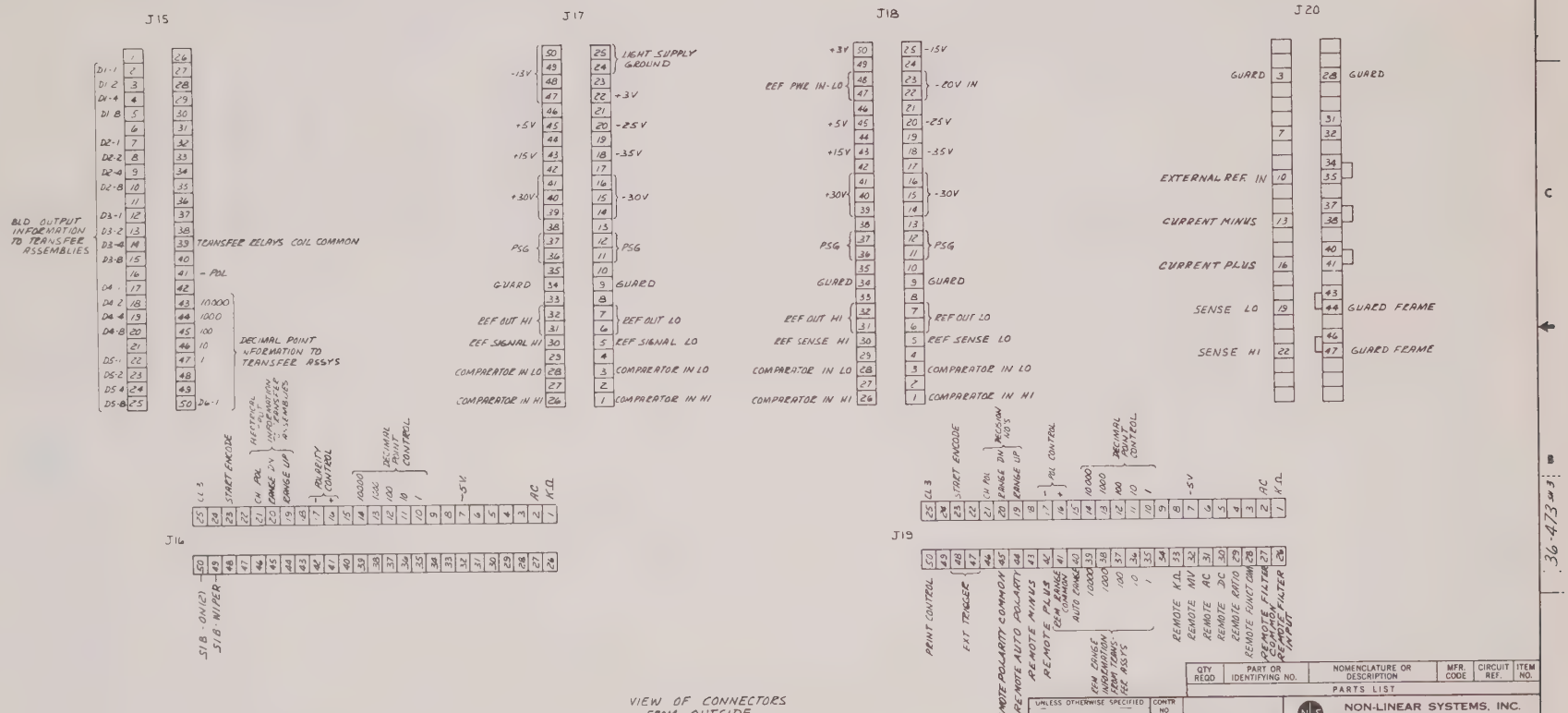
NON-LINEAR SYSTEMS, INC.
DEL MAR CALIFORNIA

WIRING DIAGRAM
POWER SUPPLY UNIT
SERIES X-1

R 03626 36-4

SHEET 2 OF 3

REVISIONS					
ZONE	LTR	EFFECT.	DESCRIPTION	DATE	APPROVED
	A	ALL	ADDED "GUARD" TO J17-34 AND CHGD "-6V" FROM J16-5 TO J16-7	1-7-67	[illegible]



VIEW OF CONNECTORS FROM OUTSIDE

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

CONTR NO

DRAWN	Tom Druckers	10-31-66
CHECK	D. FOLEY	10-31-66
APPR	[signature]	11/1/66
RELEASE DATE		

MATERIAL

36-472 NEXT ASSY	36-472 FINAL ASSY	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY	

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

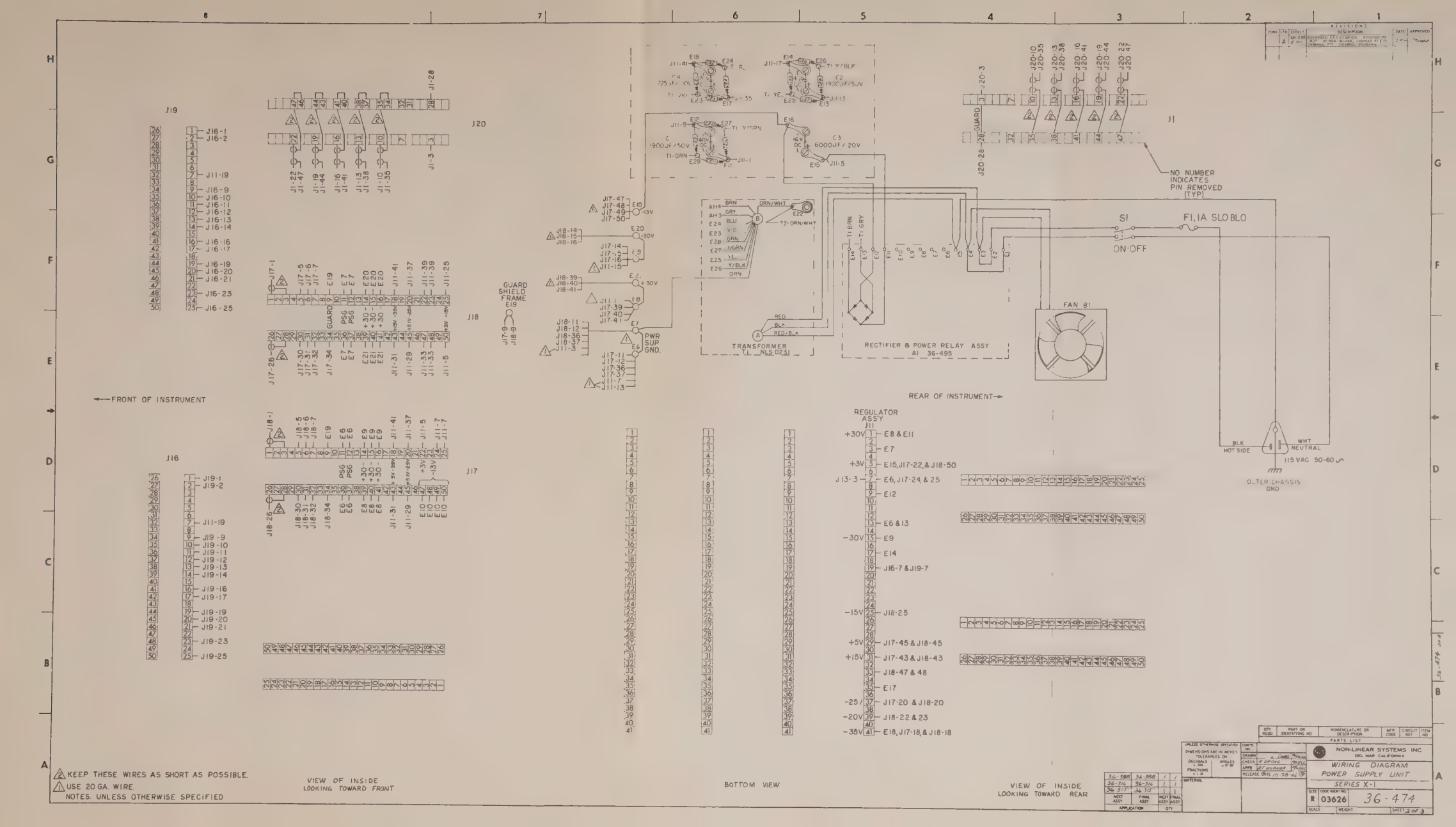
CONNECTOR PIN DESIGNATIONS INTERNAL

SERIES X-1

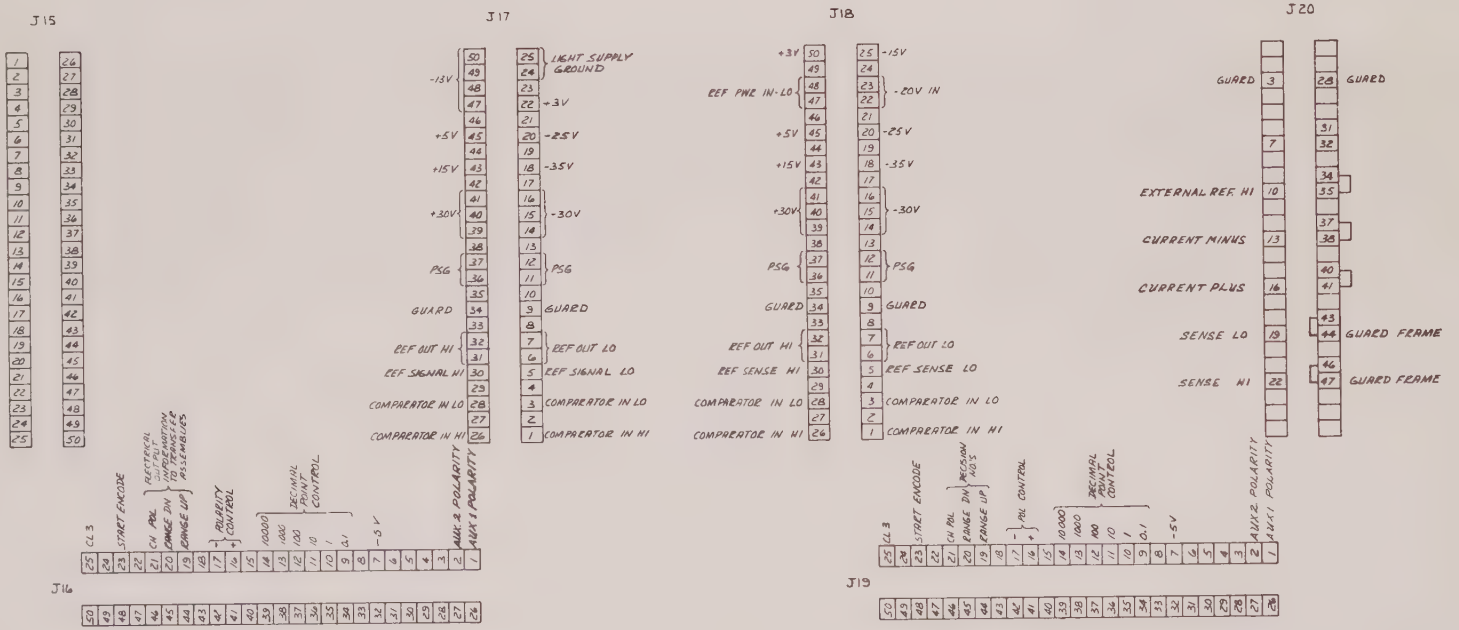
SIZE	CODE IDENT NO.	
D	03626	36-473

SCALE | WEIGHT | SHEET 3 OF 3

36-473 sh 3


J19
J16
J20
J18
J17
J1
J11
J13
J12
J14
J15
J1-28
J1-3
J1-22
J1-47
J1-19
J1-44
J1-16
J1-41
J1-13
J1-38
J1-10
J1-35
J17-1
J18-1
J16-1
J16-2
J16-9
J16-10
J16-11
J16-12
J16-13
J16-14
J16-16
J16-17
J16-19
J16-20
J16-21
J16-23
J16-25
J11-19
J19-1
J19-2
J19-9
J19-10
J19-11
J19-12
J19-13
J19-14
J19-16
J19-17
J19-19
J19-20
J19-21
J19-23
J19-25
J17-26
J18-26
J17-47
J17-48
J17-49
J17-50
J18-14
J18-15
J18-16
J17-14
J17-15
J17-16
J17-17
J18-39
J18-40
J18-41
J18-11
J18-12
J18-36
J18-37
J11-3
J17-11
J17-12
J17-36
J17-37
J11-7
J11-13
J17-9
J18-9
GUARD SHIELD FRAME
E19
E10 -13V
E20 -30V
E9
E8 +30V
E6
PWR SUP GND.
E11
E12
E13
E14
E15
E16
E17
E18
E23
E24
E25
E26
E27
E28
C4 .725 µF 10%
C2 1900 UF/5UV
C1 1900UF/50V
C3 6000UF/20V
T1 Y/BLK
T1 YE.
T1 Y/GRN
T1-GRN
J11-41
J11-17
J11-9
J11-1
J11-5
J11-13
J20-3
J20-10
J20-35
J20-13
J20-38
J20-16
J20-41
J20-19
J20-44
J20-22
J20-47
J20-28
GUARD
NO NUMBER INDICATES PIN REMOVED [TYP]
BRN
GRY
BLU
V O
GRN
Y/GRN
YE.
Y/BLK
ORN
ORN/WHT
T2-ORN/WHT
RED
BLK
RED/BLK
TRANSFORMER T1 NLS D231
RECTIFIER & POWER RELAY ASSY A1 36-495
T1 BRN
T1 GRY
S1
ON-OFF
F1, 1A SLO BLO
FAN B1
BLK HOT SIDE
WHT NEUTRAL
115 VAC 50-60 ~
OUTER CHASSIS GND
FRONT OF INSTRUMENT
REAR OF INSTRUMENT
REGULATOR ASSY J11
+30V E8 & E11
E7
+3V E15, J17-22, & J18-50
J13-3 E6, J17-24, & 25
E12
E6 & 13
-30V E9
E14
J16-7 & J19-7
-15V J18-25
+5V J17-45 & J18-45
+15V J17-43 & J18-43
J18-47 & 48
E17
-25V J17-20 & J18-20
-20V J18-22 & 23
-35V E18, J17-18, & J18-18
KEEP THESE WIRES AS SHORT AS POSSIBLE.
USE 20 GA. WIRE.
NOTES. UNLESS OTHERWISE SPECIFIED
VIEW OF INSIDE LOOKING TOWARD FRONT
BOTTOM VIEW
VIEW OF INSIDE LOOKING TOWARD REAR
REVISIONS
PARTS LIST
NON-LINEAR SYSTEMS INC
OCEANSIDE CALIFORNIA
WIRING DIAGRAM
POWER SUPPLY UNIT
SERIES X-1
SIZE R
CODE IDENT NO 03626
36-474
SCALE
WEIGHT
SHEET 2 OF 3

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
	A	ALL	ADDED "GUARD" TO J17-34 JAC ADDED "AUX.1 POLARITY" TO J19-1 ADDED "AUX.2 POLARITY" TO J19-2 DELETED "EXT REF LO" FROM J20-7 CHGD. "-5V" FROM J16-5 TO J16-7	1-11-67	



VIEW OF CONNECTORS FROM OUTSIDE

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

36-388	36-388	1	1
36-316	36-316	1	1
36-315	36-315	1	1
NEXT ASSY.	FINAL ASSY	NEXT ASSY.	FINAL ASSY.
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

CONTR. NO.
DRAWN J.A COMBS 11-2-66
CHECK 11-2-66
APPR 11-2-66
RELEASE DATE 11-2-66

NON-LINEAR SYSTEMS, INC.
OCD. MAR. CALIFORNIA

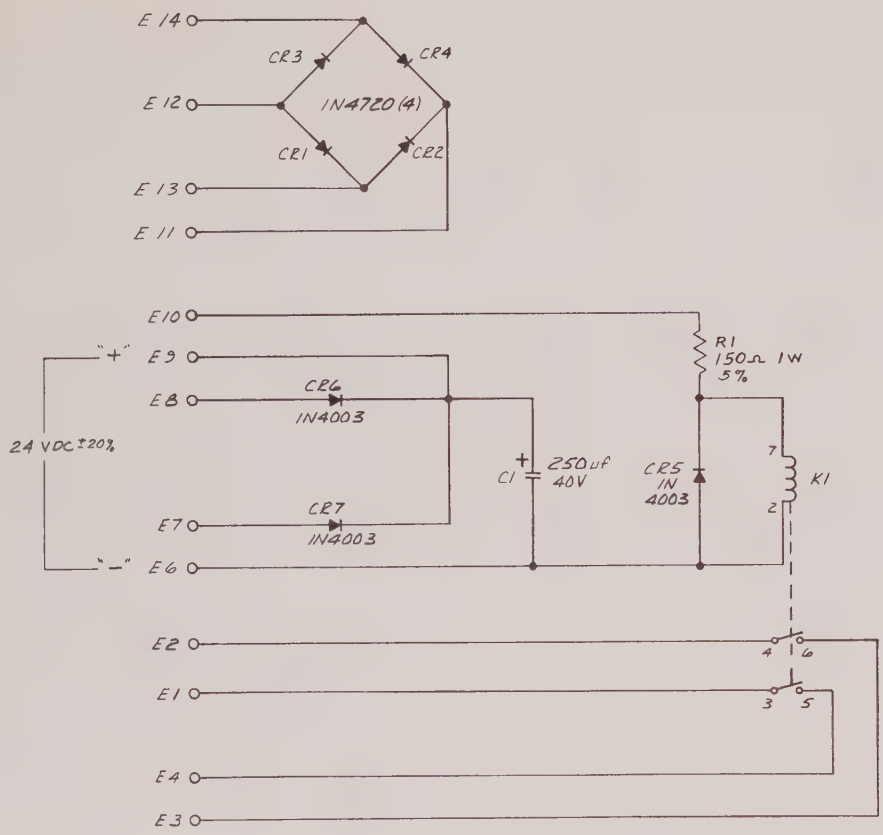
CONNECTOR PIN DESIGNATIONS INTERNAL

SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-474
SCALE	WEIGHT	SHEET 3 OF 3

36-474 #3

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED



E5 ⊙ TIE PT. (OUTER CHASSIS GND)

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED	CONTR. NO.		
DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ± .010 ANGLES ± 0° 30' FRACTIONS ± 1/32	DRAWN	TOM DEUCHARS	10-20-66
	CHECK	D FOLEY	10-21-66
	APPR	R. Nahmer	11-11-66
	RELEASE DATE	11-14-66 (1)	
MATERIAL			

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC -
RECTIFIER POWER

SERIES X-1

SIZE	CODE IDENT NO.	
C	03626	36-485

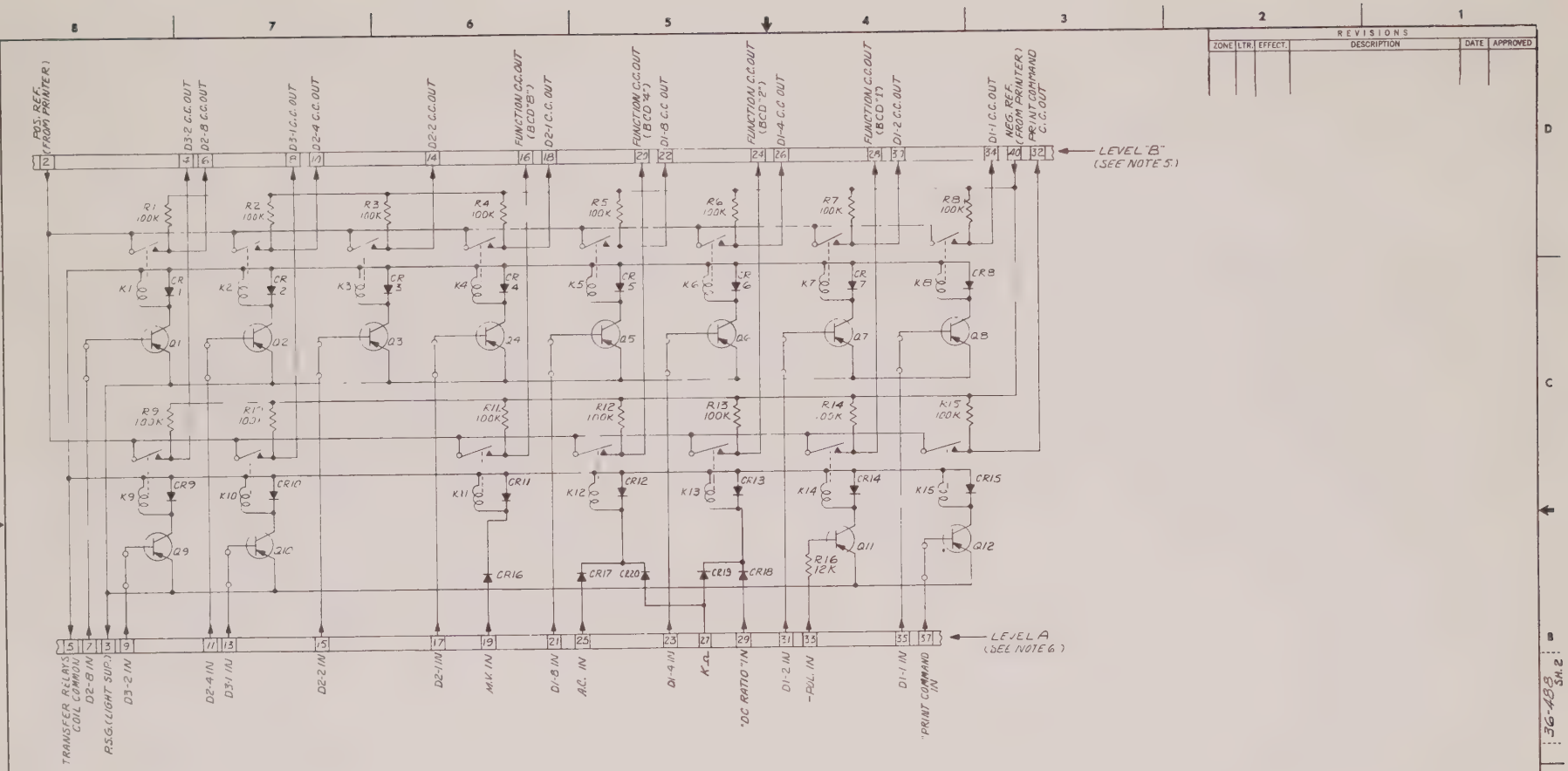
SCALE | WEIGHT | SHEET 2 OF 3

36-473	36-472	1	1
NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
APPLICATION		QTY.	

1. REFERENCE DESIGNATIONS ARE ABBREVIATED; PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY

NOTES UNLESS OTHERWISE SPECIFIED

36-485 SH 2



7. REFERENCE DESIGNATIONS ARE ABBREVIATED; PREFIX WITH ASSY. DESIG. SHOWN ON SH. 2 OF FINAL ASSY.
6. LEVEL 'A' MEANS PINS CONNECTED TO INSIDE WORLD" CIRCUITRY BY P.C. - ODD NUMBERED PINS NEAREST REAR OF METER.
5. LEVEL 'B' MEANS PINS CONNECTED TO "OUTSIDE WORLD" CIRCUITRY USING HARDWIRE ON COMPONENT SIDE OF BOARD, EVEN NUMBERED PINS NEAREST FRONT OF METER.
4. ALL TRANSISTORS ARE 2N3644 / SK7431.
3. ALL RELAYS ARE NLS TYPE S-12-27.
2. ALL DIODES ARE NLS TYPE 5003-002.
1. ALL RESISTORS ARE 1/4W, 5%.

NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS					
ZONE	LTR	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
36-472	36-472	1	1
36-468	36-468	1	1
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

CONTR. NO.
DRAWN Tim Dempsey 10-20-66
CHECK D. RILEY 10-27-66
APPR M. Johnson 11/2/66
RELEASE DATE
MATERIAL

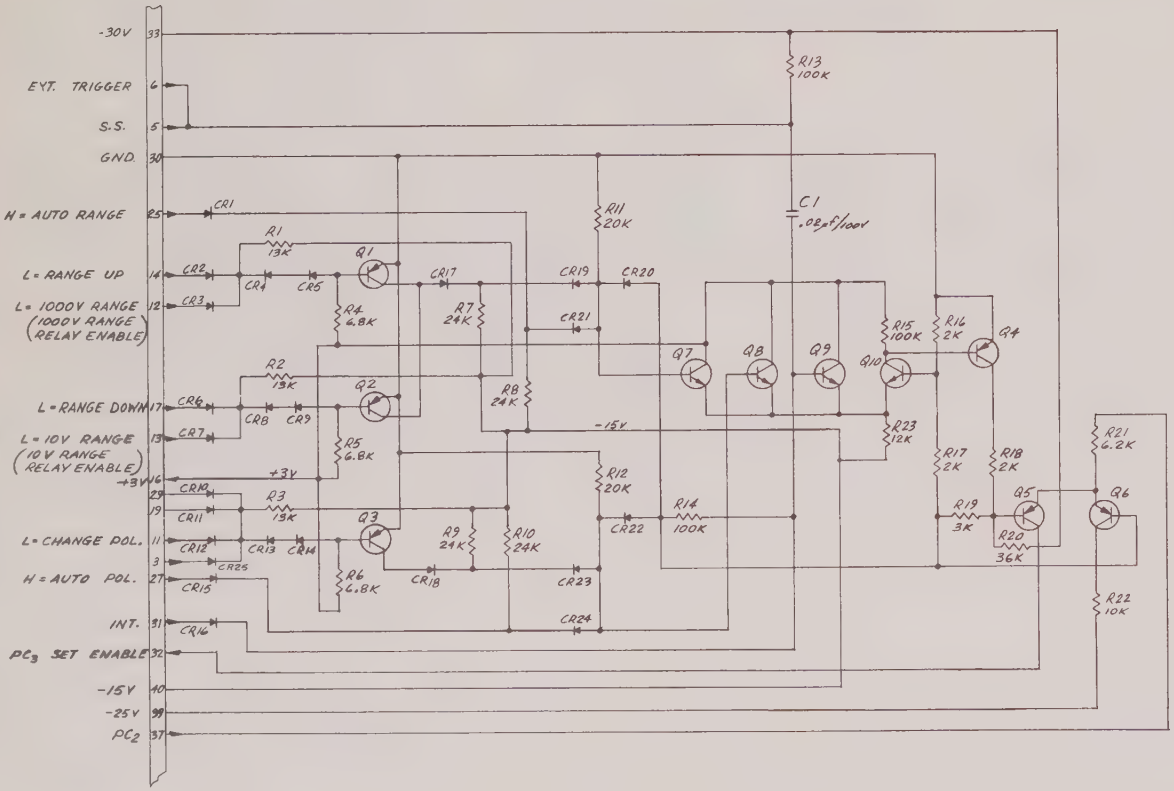
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC-
TRANSFER BD NO 2
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-488

SCALE | WEIGHT | SHEET 2 of 2

36-488 SH. 2



REVISIONS					
ZONE	LTR	EFFECT	DESCRIPTION	DATE	APPROVED
B7	A	30V, -15 & -25V	INCORPORATED E.O.1 OF REV.'C' BOM.	12-8-66	J. Mayfield

REFERENCE DESIGNATIONS ARE ABBREVIATED PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY

4. NPN TRANSISTORS ARE 2N3904/2N3565/2N3711.
3. PNP TRANSISTORS ARE 2N3906/2N3638A/2N3702.
2. DIODES ARE NLS 5003-002
1. RESISTORS ARE 1/4 W., ±5%, CARBON.

NOTES UNLESS OTHERWISE SPECIFIED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF	ITEM NO

PARTS LIST

NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY
36-225	36-225	/	/
36-316	36-316	/	/
36-315	36-315	/	/
APPLICATION		QTY	

MATERIAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO
DRAWN W. HICKLAND 10-21-66
CHECK J. Mayfield 10-25-66
APPR. [illegible] 10-25-66
RELEASE DATE 10-26-66

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

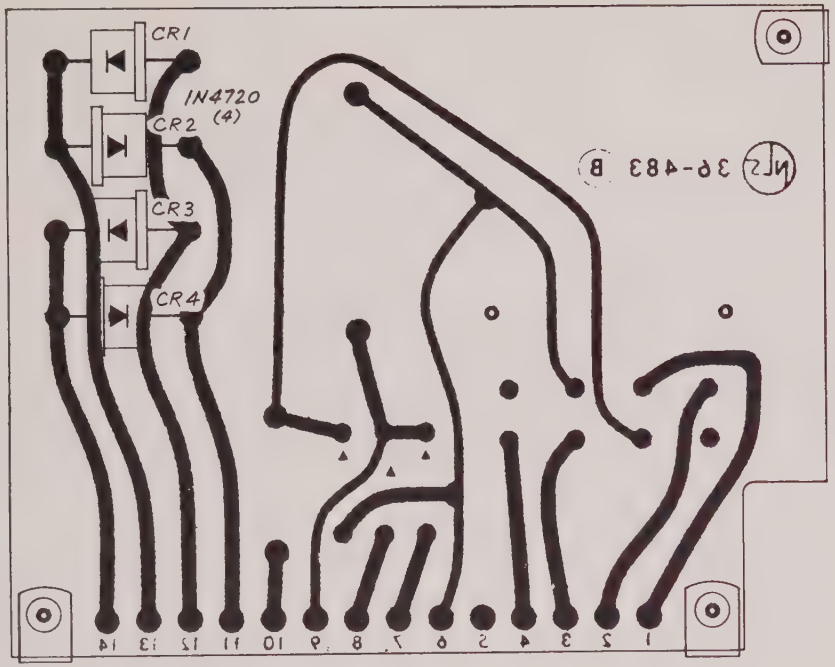
SCHEMATIC
SCAN CONTROL ASS'Y.
SERIES X-1 (REPLACES SCAN COUNTER ON VOLTMETERS)

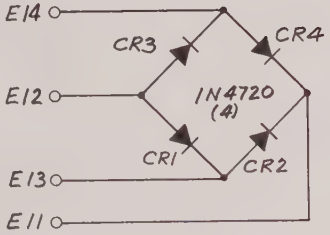
SIZE D | CODE IDENT NO 03626 | 36-494

SCALE | WEIGHT | SHEET 2 OF 2

36-494

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED





QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.
4	IN 4720	DIODE	04713	CR1-4	2
1	36-484	PC BOARD, SUB-ASY			1

PARTS LIST

UNLESS OTHERWISE SPECIFIED	CONTR. NO.		
DIMENSIONS ARE IN INCHES	DRAWN	[illegible]	11-11-66
TOLERANCES ON	CHECK	[illegible]	11-14-66
DECIMALS ± .010 / ANGLES ± 0° 30'	APPR	R.T. Warner	11-14-66
FRACTIONS ± 1/32	RELEASE DATE	11-14-66	
MATERIAL			

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

RECTIFIER ASSY-

SERIES X-1

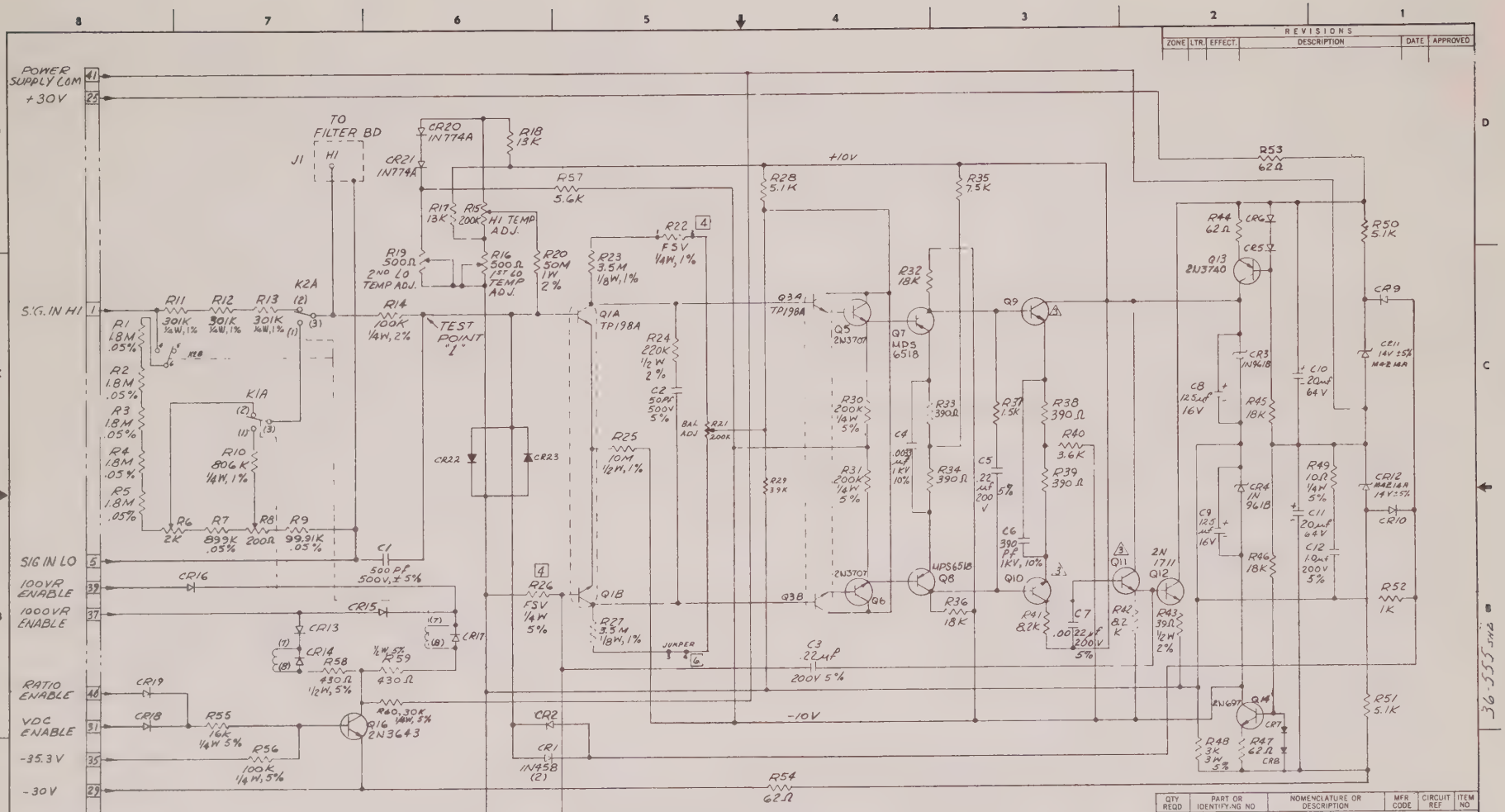
SIZE	CODE IDENT NO.	
C	03626	36-495

SCALE | WEIGHT | SHEET 1 OF 1

36-470	36-468	1	1
NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
APPLICATION		QTY.	

REFERENCE DESIGNATIONS ARE ABBREVIATED; PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY

36-495



REVISIONS					
ZONE	LTR	EFFECT.	DESCRIPTION	DATE	APPROVED

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIODES ARE NLS5003-002
2. ALL RESISTORS ARE 1/4W, 2%
3. 2N3904, 2N3565, 2N3711 Q9 & Q10 TO BE SAME MANUFACTURER TYPE
4. R22 & R26 ARE FACTORY SELECTED VALUES REFER TO DOC. NO. 724. (R26 CAN BE SELECTED FROM THE FOLLOWING VALUES: 2.7K, 3.0K, 3.3K, 3.6K, 3.9K & 4.7K

5 REF DESIGNATIONS ARE ABBREVIATED; PREFIX WITH ASSY DESIGNATION SHOWN ON SH 2 OF FINAL ASSY.
6 ALTERNATE LOCATION FOR R22. REF NOTE 3 SH 1.
7 R1-5, 7, & 9 ARE PW2016 NC.

NEXT ASSY	FINAL ASSY.	NEXT ASSY	FINAL ASSY
36-448	36-468	/	/
36-218	36-218	/	/
APPLICATION		QTY.	

QTY REQD	PART OR IDENTIFY-NG NO	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO

PARTS LIST

UNLESS OTHERWISE SPECIFIED CONTR. NO
DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ± .010 FRACTIONS ± 1/32 ANGLES ± 0° 30'
MATERIAL

DRAWN	Tom Deuchars	12-12-66
CHECK	R. Dove	12-14-66
APPR	[illegible]	1-17-67
RELEA'	DATE	

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

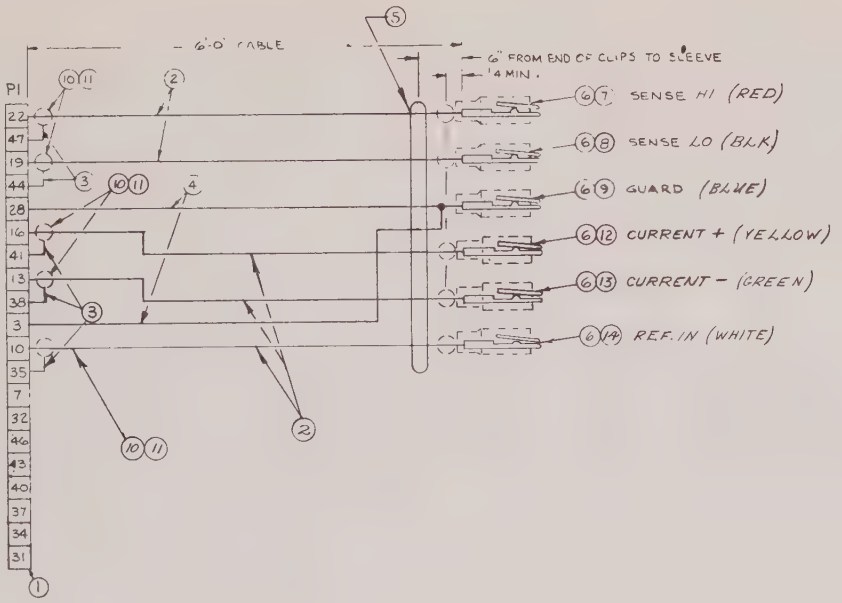
SCHEMATIC - BUFFER

SERIES X-1

SIZE	CODE IDENT NO	
D	03626	36-555
SCALE	WEIGHT	SHEET 2 OF 3

36-555 SH2

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED
1B	A	ALL	ADDED INSERT PART NO. TO ITEM 1. ADDED WIRE LENGTH. WAS A/R	11-Feb-66	J. Kruspe



NOTES:
1. STAMP PART NO. 15004-525 ON SLEEVING.
2. STAMP SYMBOL P1 ON SLEEVE AT REAR CONNECTOR.
3. REMOVE ALL PINS NOT SHOWN ON P1

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.
1	62-WHITE	INSULATOR, WHT. VINYL	95432		14
1	62-GREEN	INSULATOR, GRN. VINYL	95432		13
1	62-YELLOW	INSULATOR, YEL. VINYL	95432		12
10	3/16 x 2 1/2	TUBING, SHRINK	THERMOFIT		11
5	323930	TERMASHIELD	89110		10
1	62 BLUE	INSULATOR, BLUE VINYL	95432		9
1	62 BLACK	" , BLACK VINYL	"		8
1	62-RED	INSULATOR, RED VINYL	"		7
6	60-CS	CLIP, COPPER	95432		6
5'6"	V105	SLEEVING, VINYL 3/16 I.D. BLK.	05593		5
12"	#20 AWG	WIRE, STRANDED - BLK.			4
15"	#22 AWG	WIRE, STRANDED - BLK.			3
30'	26 1459A/10	COAX: HL CABLE #9269	70903		2
1	57-30500/57-1222	CONNECTOR - 50 PIN WITH HI BARRIER INSERT	02660	P1	1

PARTS LIST

NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
36-218	36-218	1	1
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.
DRAWN W.A.COMBS 2-2-66
CHECK [illegible] 2-17-66
APPR [illegible]
RELEASE DATE
MATERIAL

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

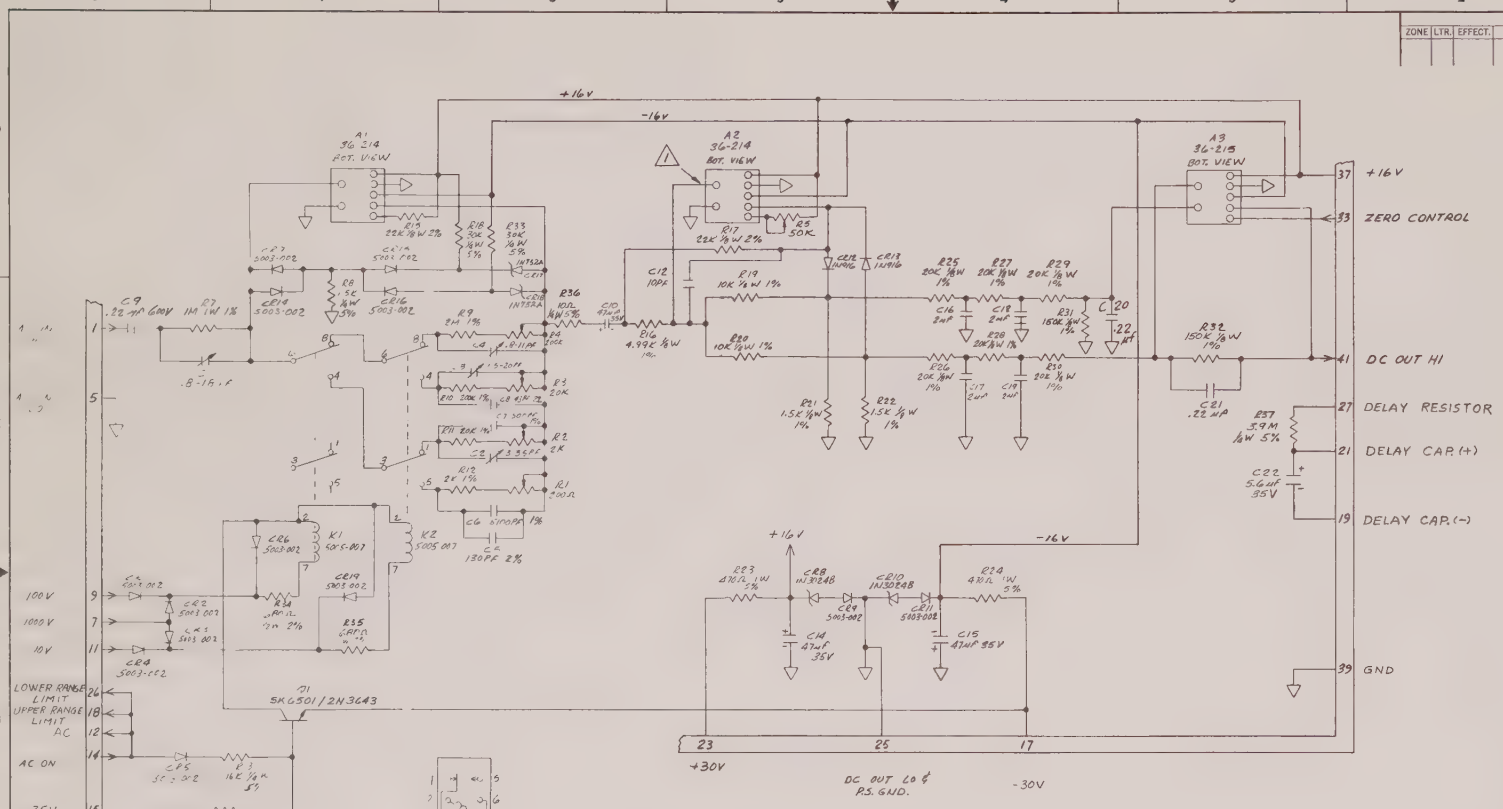
CABLE - INPUT

USED ON SERIES X-1

SIZE	CODE IDENT NO.	
C	03626	15004-525

SCALE NONE | WEIGHT | SHEET 1 of 1

15004-525



CALIBRATION INSTRUCTIONS

PROC. NO.	RANGE	INPUT	ADJUST
			FRONT PANEL CONTROL
1	1000V	0	
2	1000 V	500V - 200 HZ	R1
3	1000 V	500V - 10K HZ	C1
4	100 V	100V - 200 HZ	R2
5	100 V	100V - 10K HZ	C2
6	10 V	10V - 200 HZ	R3
7	10 V	10V - 10K HZ	C3
8	1V	1V - 200 HZ	R4
9	1V	1V - 10K HZ	C4

REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX WITH
2. ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY

1 THIS POINT SHOULD MEASURE 0v ± 1MV. IF NOT, ADJUST R5.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.
DRAWN WEINBERG 7-29-66
CHECK [illegible] 10-17-66
APPR [illegible] 10-17-66
RELEASE DATE 10-19-66

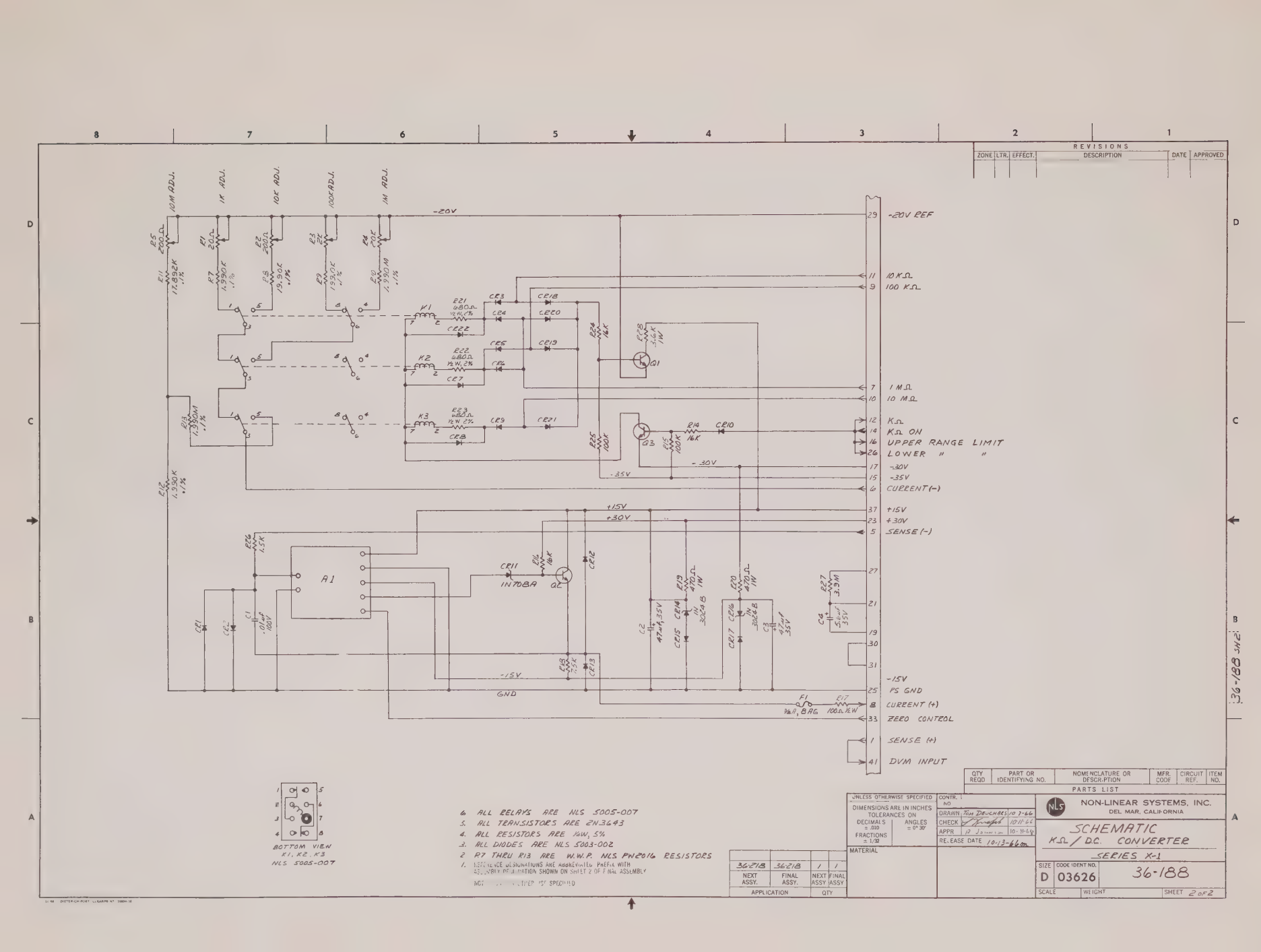
MATERIAL

3G-218 NEXT ASSY	3G-218 FINAL ASSY	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY	

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC
AC/DC CONVERTER
SERIES X1

SIZE	CODE IDENT NO	
D	03626	3G-97
SCALE	WEIGHT	SHEET 2 OF 2



REVISIONS

ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

PARTS LIST

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF.	ITEM NO.

6. ALL RELAYS ARE NLS 5005-007
5. ALL TRANSISTORS ARE 2N3643
4. ALL RESISTORS ARE ¼W, 5%
3. ALL DIODES ARE NLS 5003-002
2. R7 THRU R13 ARE W.W.P. NLS PW2016 RESISTORS
1. REFERENCE DESIGNATIONS ARE ABBREVIATED PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY

NOT ... UNLESS OTHERWISE SPECIFIED

36218 NEXT ASSY.	36218 FINAL ASSY.	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

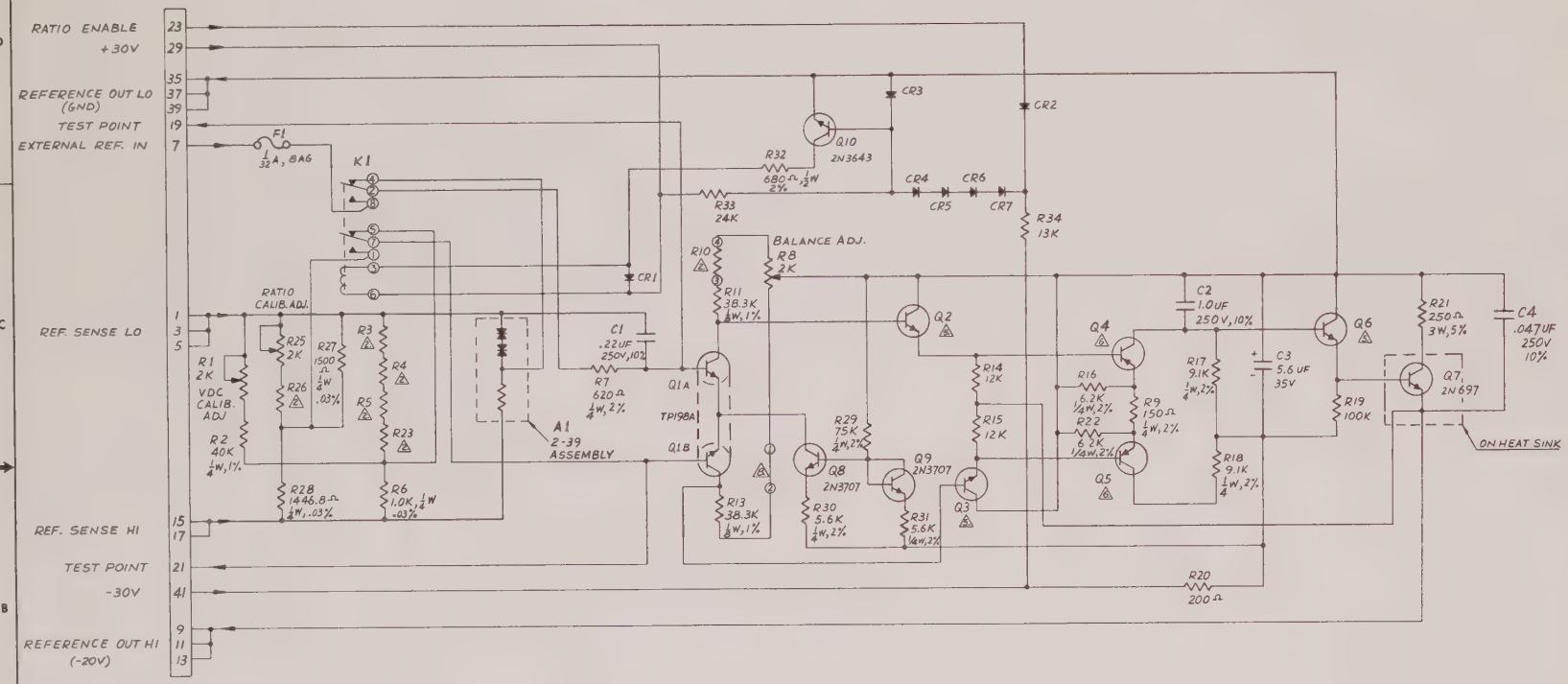
CONTR. NO.
DRAWN Tom Deschaes 10 7-66
CHECK [signature] 10 11 66
APPR [signature] 10-11-66
RELEASE DATE 10-13-66

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC
KΩ / DC. CONVERTER
SERIES X-1

SIZE D | CODE IDENT NO. 03626 | 36-188
SCALE | WEIGHT | SHEET 2 OF 2

36-188 SH2



REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

10. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH THE ASSEMBLY DESIGNATION A3A10.
9 REFER TO DOC NO. 765 FOR ADJUSTING R25 & FOR SELECTION OF R26.
⚠ ALTERNATE LOCATION FOR R10. REF 36-195 SHT 1 NOTE 4
7 DIODES ARE 5003-002
⚠ 2N3906, 2N3638A, MPS651B, 2N3702.
⚠ 2N3904, 2N3711, 2N3565.
4. DOCUMENT 719 GIVES INSTRUCTION FOR ADJUSTING R1
3. DOCUMENT 715 GIVES INSTRUCTION FOR ADJUSTING R8.
⚠ RESISTORS R3, 4, 5, 10 & 23 ARE SELECTED, SEE DOC. 715.
1. RESISTORS ARE 1/4W, 5%
NOTES: UNLESS OTHERWISE SPECIFIED.

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.
PARTS LIST					

36-383	36-383	1	1
36 222	36-222	1	1
NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010 ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

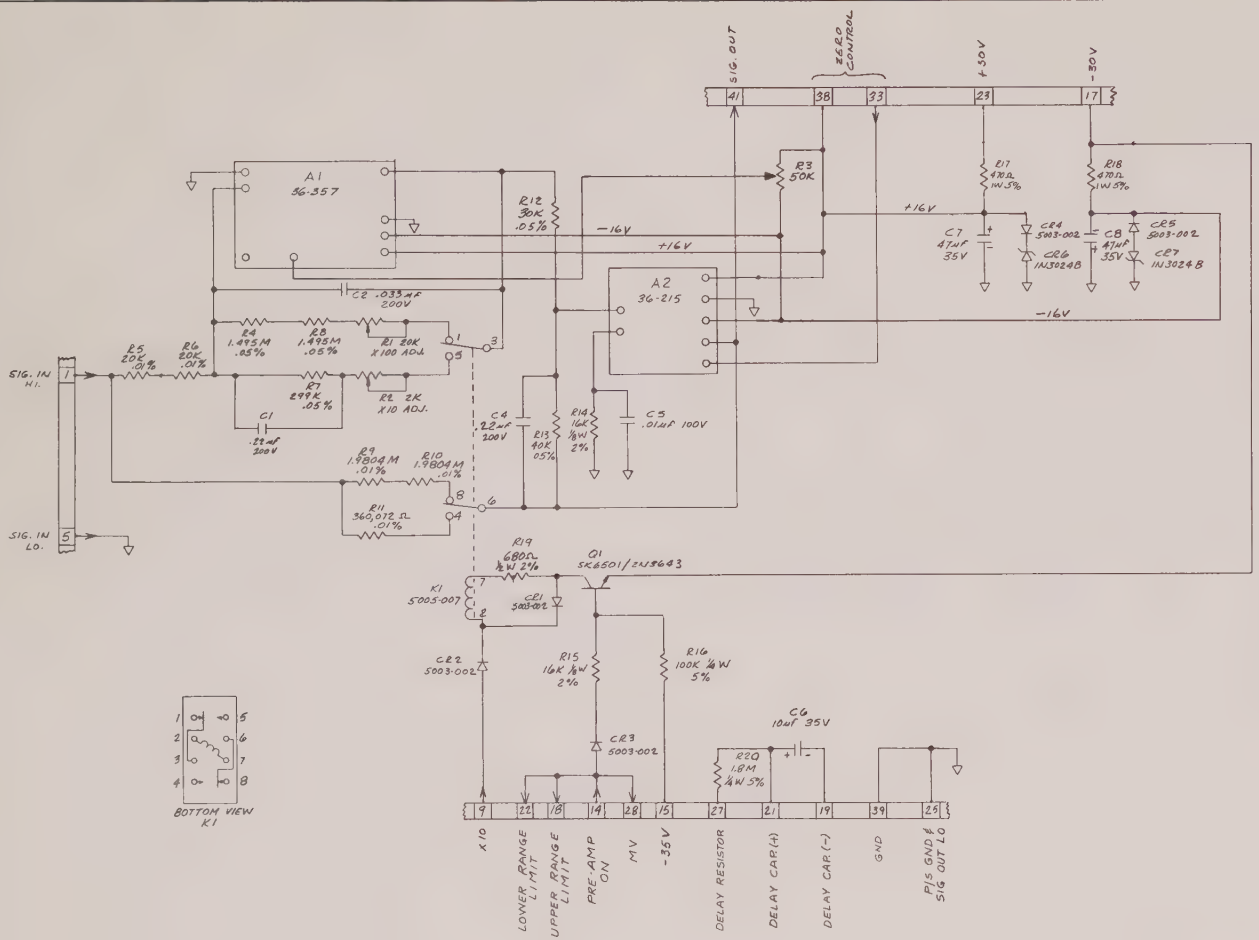
CONTR. NO.
DRAWN H BRINLEY 8-1-66
CHECK [illegible] 8-16-66
APPR [illegible] 8-16-66
RELEASE DATE 8-17-66

NLS NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC, RATIO REFERENCE SUPPLY
SERIES X1

SIZE	CODE IDENT NO.	
D	03626	36-195
SCALE	WEIGHT	SHEET 2 of 2

36-195 SHT 2



NOTES:

1. R9 THRU R13 ARE NLS W.W.P. PW2016 RESISTORS.

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO
DRAWN WEINBERG 7-29-66
CHECK [illegible] 10-17-66
APPR K. [illegible] 11-7-66
RELEASE DATE 10-17-66 (?)

MATERIAL SEE SH-1

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

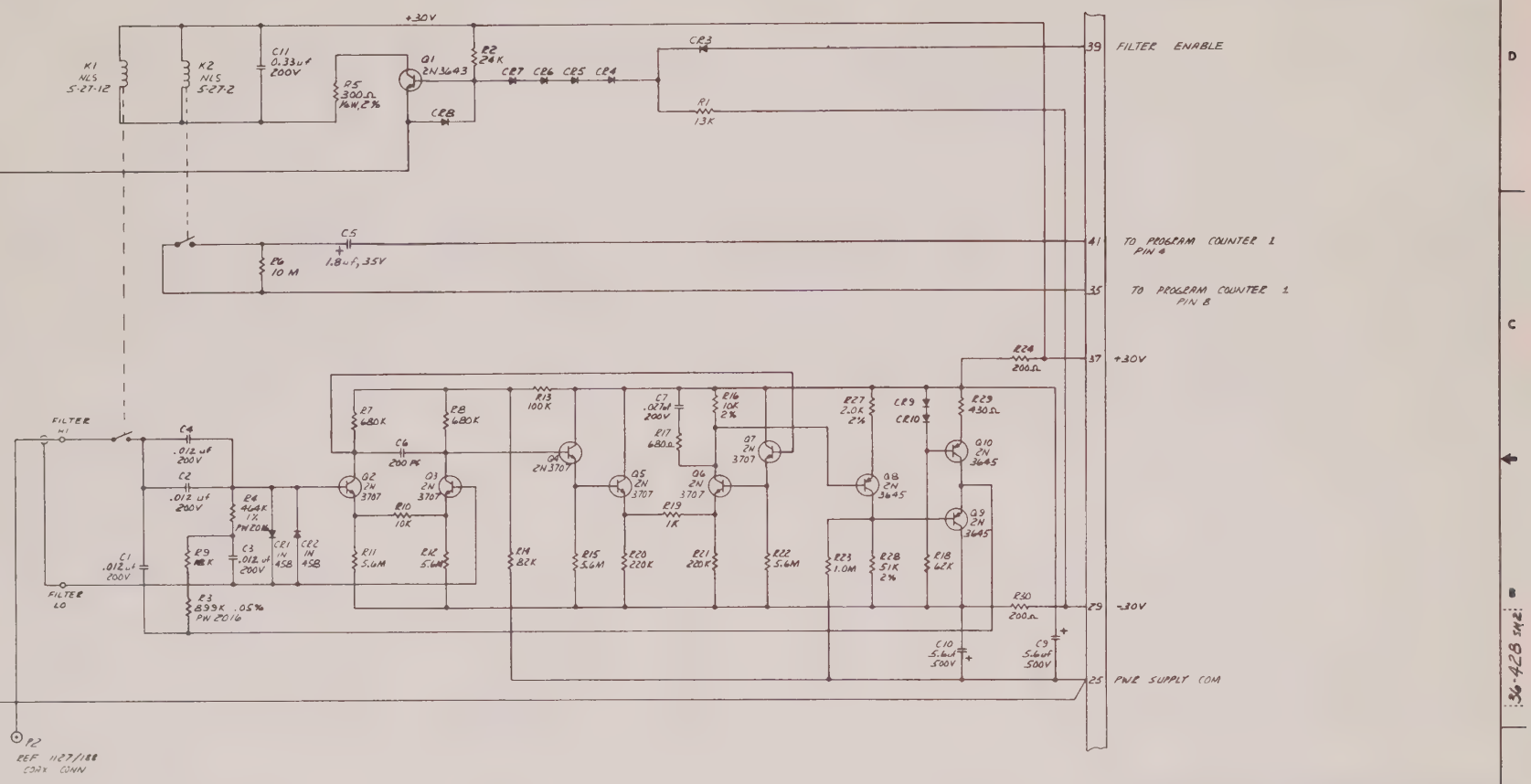
— SCHEMATIC —
PRE-AMPLIFIER
SERIES X1

SIZE	CODE IDENT NO.	
D	03626	36-234

SCALE | WEIGHT | SHEET 2 OF 2

36-218 NEXT ASSY.	36-218 FINAL ASSY.	1 NEXT ASSY	1 FINAL ASSY
APPLICATION		QTY	

36-234 SH2



QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO

PARTS LIST

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

3. DIODES ARE NLS 5003-002
2. RESISTORS ARE 1/4W, 5%
1. REFERENCE DESIGNATIONS ARE ABBREVIATED, PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY.	FINAL ASSY.	NEXT ASSY	FINAL ASSY.
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

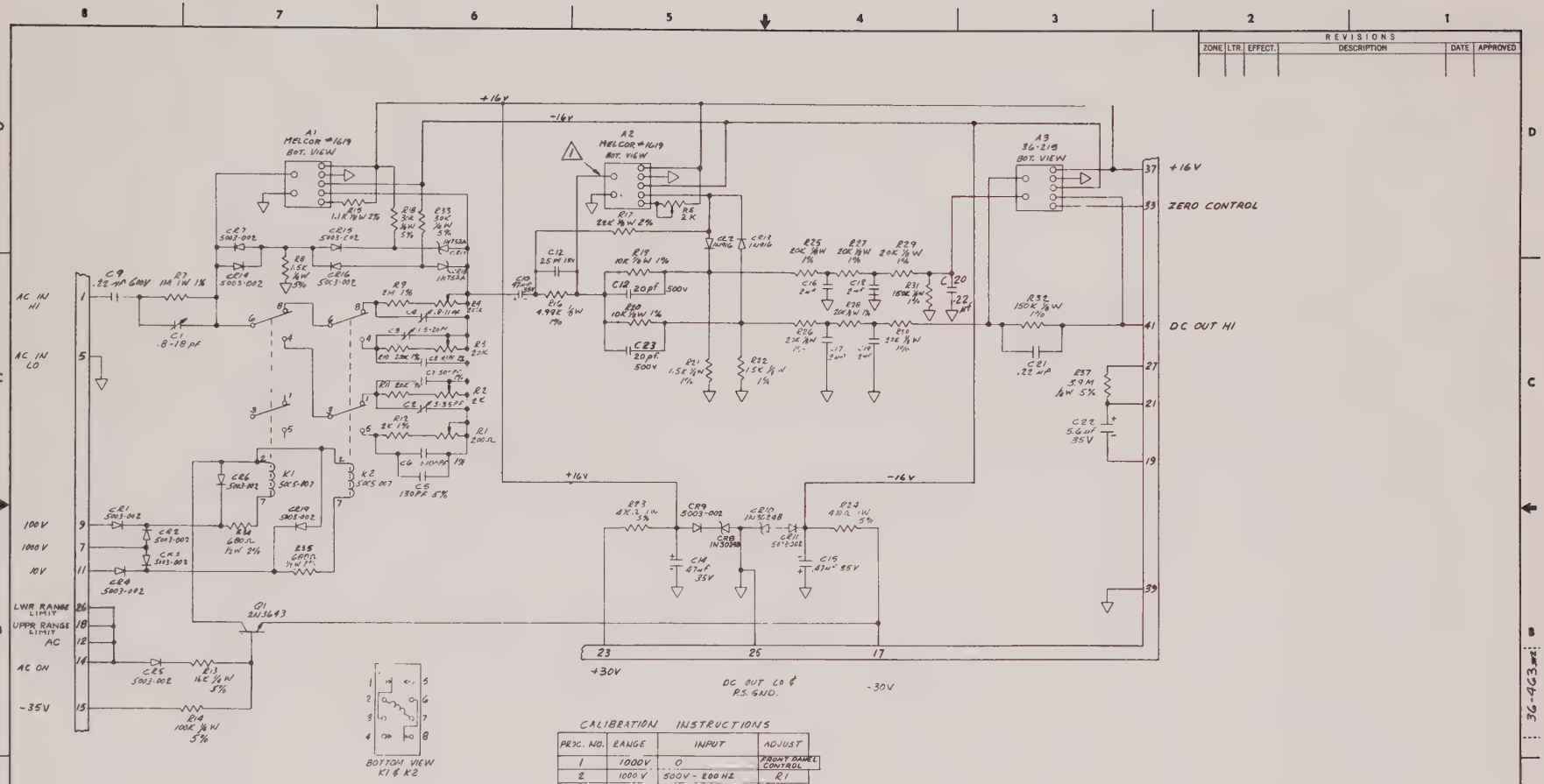
CONTR. NO.
DRAWN Tom Duncan 11-8-66
CHECK Doug 1-11-67
APPR R. Williamson 1-12-67
RELEASE DATE 1-16-67
MATERIAL

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC -
ACTIVE FILTER - HIGH SPEED
SERIES X-1

SIZE	CODE IDENT NO	
D	03626	36-428
SCALE	WEIGHT	SHEET 2 of 3

36-428 SH2



CALIBRATION INSTRUCTIONS

PROC. NO.	RANGE	INPUT	ADJUST
1	1000V	0	FRONT PANEL CONTROL
2	1000 V	500V - 200 HZ	R1
3	1000 V	50CV - 80K HZ	C1
4	100 V	100V - 200 HZ	R2
5	100 V	100V - 80K HZ	C2
6	10 V	10V - 200 HZ	R3
7	10 V	10V - 80K HZ	C3
8	1 V	1V - 200 HZ	R4
9	1 V	1V - 80K HZ	C4

3. AFTER CALIBRATION, SPOT CHECK AT VARIOUS FREQUENCIES THROUGHOUT BANDWITH OF CONVERTER.

2. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY

⚠ THIS POINT SHOULD MEASURE 0v ± 1 MV. IF NOT, ADJUST R5.

NOTES UNLESS OTHERWISE SPECIFIED

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
FRACTIONS ± 1/32
ANGLES ± 0° 30'

CONTR. NO.
DRAWN A. Wickham 1-23-67
CHECK W. Campbell 1-23-67
APPR R. Johnson 1-25-67
RELEASE DATE 1-24-67 (RB)
MATERIAL

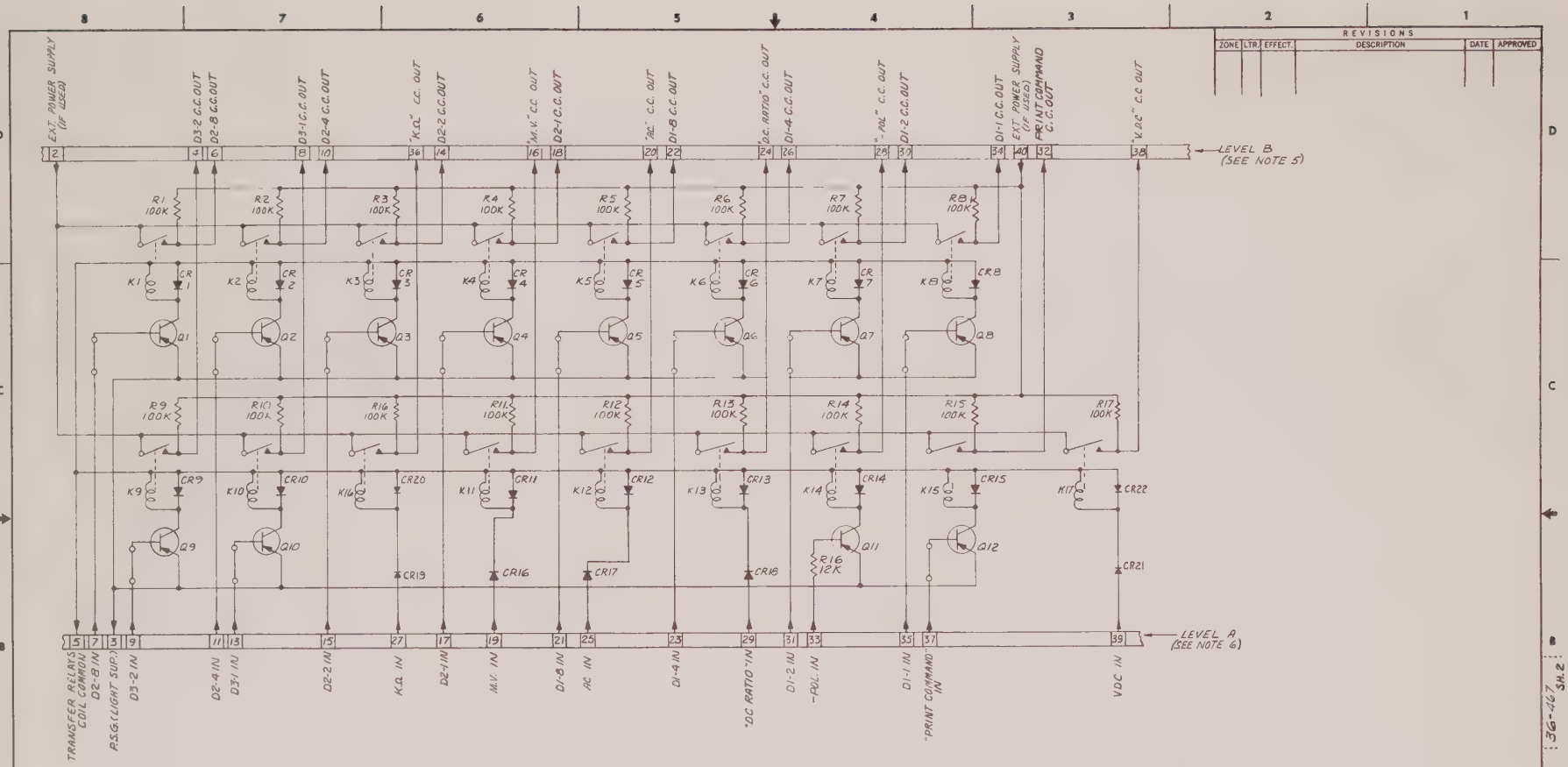
NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC
100 KHz AC/DC CONVERTER
SERIES X1

SIZE	CODE IDENT NO.	
D	03626	36-463
SCALE	WEIGHT	SHEET 2 OF 3

NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
APPLICATION		QTY.	

36-463



7. REFERENCE DESIGNATIONS ARE ABBREVIATED; PREFIX WITH ASSY. DESIG. SHOWN ON SH. 2 OF FINAL ASSY.
6. LEVEL 'A' MEANS PINS CONNECTED TO 'INSIDE WORLD' CIRCUITRY BY P.C.-ODD NUMBERED PINS NEAREST REAR OF METER.
5. LEVEL 'B' MEANS PINS CONNECTED TO "OUTSIDE WORLD" CIRCUITRY USING HARDWIRE ON COMPONENT SIDE OF BOARD, EVEN NUMBERED PINS NEAREST FRONT OF METER.
4. ALL TRANSISTORS ARE 2N3644 / SK7431.
3. ALL RELAYS ARE NLS TYPE S-12-27.
2. ALL DIODES ARE NLS TYPE 5003-002.
1. ALL RESISTORS ARE 1/4W, 5%.

NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR. CODE	CIRCUIT REF.	ITEM NO.

PARTS LIST

NEXT ASSY.	FINAL ASSY.	NEXT ASSY.	FINAL ASSY.
36-472	36-472	1	1
36-468	36-468	1	1
APPLICATION		QTY.	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010 ANGLES ± 0° 30'
FRACTIONS ± 1/32
MATERIAL

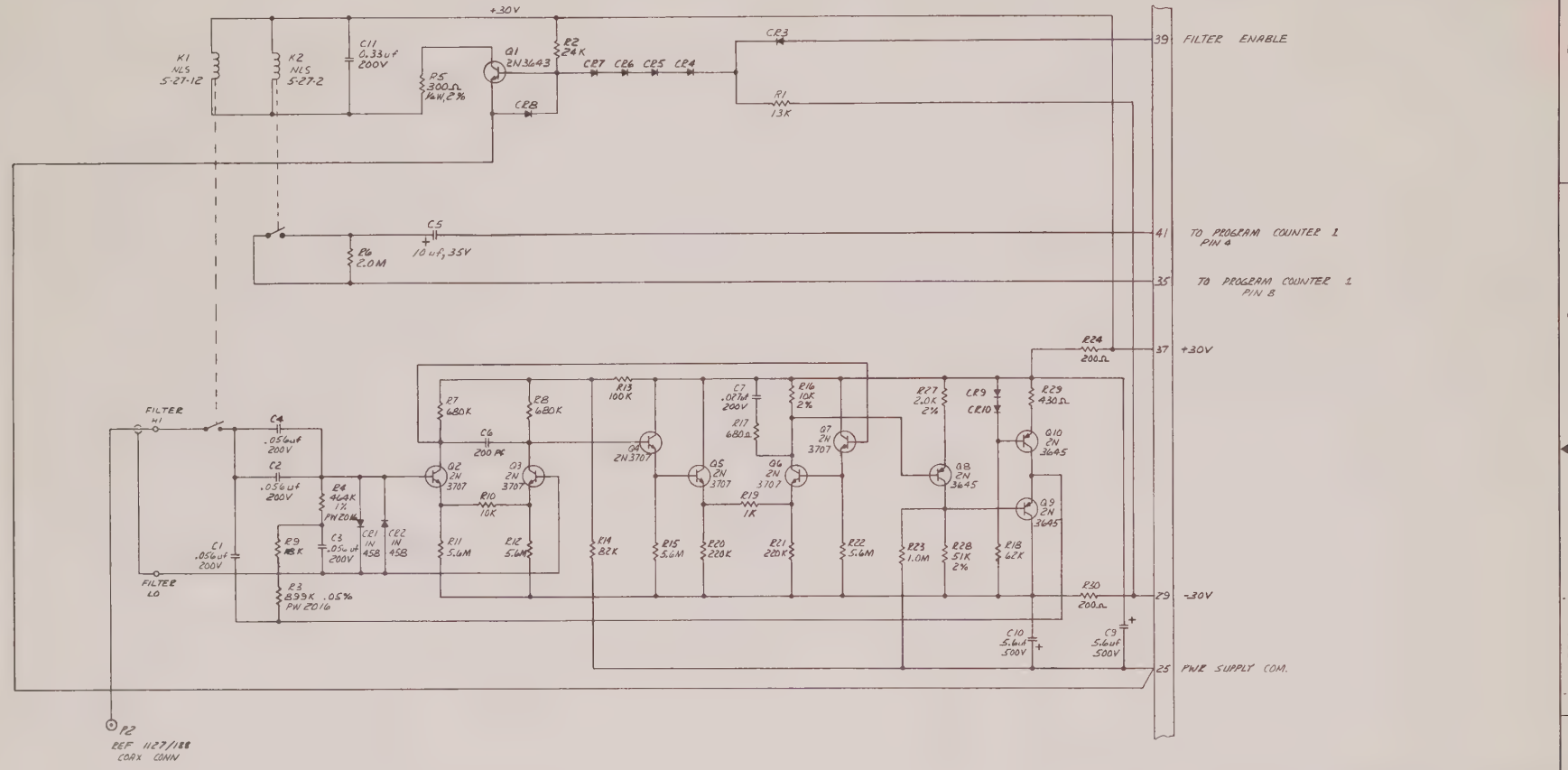
CONTR. NO.
DRAWN TOM DELICHARES 10-18-66
CHECK J. WOOD 10-19-66
APPR. Jay Fellows 10/19/66
RELEASE DATE

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC-
TRANSFER BD NO 2
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-467
SCALE	WEIGHT	SHEET 2 of 4

36-467 SH. 2



3. DIODES ARE NLS 5003-002
2. RESISTORS ARE 1/4W, 5%
1. REFERENCE DESIGNATIONS ARE ABBREVIATED, PREFIX WITH ASSEMBLY DESIGNATION SHOWN ON SHEET 2 OF FINAL ASSEMBLY.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS					
ZONE	LTR.	EFFECT.	DESCRIPTION	DATE	APPROVED

QTY REQD	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MFR CODE	CIRCUIT REF	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ± .010
ANGLES ± 0° 30'
FRACTIONS ± 1/32

CONTR. NO.
DRAWN Gil DeLoach 4-27-66
CHECK Tane 1-11-67
APPR R. Hellemann 1-13-67
RELEASE DATE 1-12-67

MATERIAL

NEXT ASSY. | FINAL ASSY. | NEXT ASSY | FINAL ASSY
APPLICATION | QTY.

NON-LINEAR SYSTEMS, INC.
DEL MAR, CALIFORNIA

SCHEMATIC -
ACTIVE FILTER - LOW SPEED
SERIES X-1

SIZE	CODE IDENT NO.	
D	03626	36-538

SCALE | WEIGHT | SHEET 2 of 9

36-538 SHT.

MODIFICATION DATA
SERIES X-1 DIGITAL VOLTMETER

POWER SUPPLY DRAWER REMOVAL
(Instruments shipped from the factory
on 23 February 1967 and all subsequent)

To remove the Power Supply Drawer from the outer chassis of the instrument, perform the following steps:

1. Remove two screws attaching the drawer to the outer chassis (one each is located in the center of the extreme outside edges of the rear of the drawer).

2. Loosen (turn counterclockwise) the two drawer fasteners (see Figure 2-3 in the Instruction Manual).

3. Carefully pull the drawer out of the outer chassis.

ERRATA

Series X-1 Digital Voltmeter Instruction Manual

Document No. 793 (DVM P/N's 36-218 & 36-315)

Document No. 812 (DVM P/N's 36-388, 36-468, 36-382 & 36-472)

Reverse the calibration procedure for the AC Converterter Assembly, i. e., calibrate the 1000-volt range first and the 1-volt range last.

METROLOGY DEPT.

non linear
systems, inc.
DEL MAR, CALIFORNIA

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1022553